Appendix F
Final Addendum to the Engineering Evaluation/Cost Analysis (EE/CA) Non-Time Critical Removal Action for Site 7, Site 4 Areas of Potential Concern (AOPCs) 1A and 2A, Naval Weapons Station Seal Beach, Seal Beach, California
July 31, 2003

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Acronyms

µg/L	micrograms per liter
AM	Action Memorandum
AOC	area of concern
AOPC	Area of Potential Concern
APR	annual percentage rate
ARAR	Applicable or Relevant and Appropriate Requirements
AUF	Area use factor
BCF	bioconcentration factor
bgs	below ground surface
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIWMB	California Integrated Waste Management Board
COPC	chemical of potential concern
cy	cubic yards
DDT	dichlorodiphenyl-trichloroethane
DHS	Department of Health Services
DON	Department of the Navy
DTSC	Department of Toxic Substances Control
EE/CA	Engineering Evaluation/Cost Analysis
EIA	Environmental Impact Assessment
EO	Executive Order
EPA	Environmental Protection Agency
EPC	exposure point concentration
ERA	ecological risk assessment

FIR	food ingestion rate
GSU	Geologic Services Unit
HERD	Human and Ecological Risk Division
HHRA	human health risk assessment
HI	hazard index
IAS	Initial Assessment Study
IR	Installation Restoration
LOAEL	lowest observed adverse effect level
mg/kg	milligram(s) per kilogram
mg/L	milligram(s) per liter
NACIP	Navy Assessment and Control of Installation Pollutants
NAVWPNSTA	Naval Weapons Station
NAWQC	national ambient water quality criteria
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEESA	Naval Energy and Environmental Support Activity
NFA	no further action
NFESC	Naval Facilities Engineering Services Center
NWR	National Wildlife Refuge
O&M	operation and maintenance
OCDD	octachlorodibenzo-p-dioxin
OCFCC	Orange County Flood Control Channel
OU	Operable Unit
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzodioxin
PCDF	polychlorinated dibenzofuran
PEL	probable effects level
ppb	parts per billion
ppm	parts per million

PRG	preliminary remediation goal
QA/QC	quality assurance/quality control
RAB	Restoration Advisory Board
RAC	Remedial Action Contractor
RAO	removal action objective
RAP	Remedial Action Plan
RAW	Removal Action Work Plan
RCRA	Resource Conservation and Recovery Act
RFA	Resource Conservation and Recovery Act Facility Assessment
rPRG	residential preliminary remediation goal
RSE	Removal Site Evaluation
RWQCB	Regional Water Quality Control Board
SCAQMD	South Coast Air Quality Management District
SI	Site Inspection
SVOC	semivolatile organic compound
SWDIV	Southwest Division, Naval Facilities Engineering Command
SWMU	solid waste management unit
TAL	target analyte list
TBC	to be considered
TCDD	tetrachlorodibenzo-p-dioxin
TCG	target cleanup goal
TDS	total dissolved solids
TEF	toxicity equivalency factor
TEL	threshold effects level
TPHd	total petroleum hydrocarbons as diesel
TRPH	total recoverable petroleum hydrocarbons
TRV	toxicity reference valve
TTLC	toxic threshold limit concentration
U.S.	United States

U.S.C.	United States Code
ULBV	upper-limit background value
USFWS	United States Fish and Wildlife Service
XRF	x-ray fluorescence

F1. Introduction

This Appendix is an addendum to the *Engineering Evaluation/Cost Analysis (EE/CA), Non-Time Critical Removal Action for Site 7* (Southwest Division, Naval Facilities Engineering Command [SWDIV], 2002) (hereafter, referred to as the *Site 7 EE/CA*), identifies and evaluates proposed removal action alternatives to mitigate or prevent damage to public health or welfare or to protect the environment from lead-contaminated soil at Installation Restoration (IR) Site 4 Areas of Potential Concern (AOPCs) 1A and 2A, of the Naval Weapons Station (NAVWPNSTA), Seal Beach. This addendum was prepared to extend the removal actions of Site 7 to include the adjacent areas of Site 4 AOPCs 1A and 2A.

Site 4 AOPCs 1A and 2A are a 5,400-foot by 100-foot-wide unpaved shoulder adjacent to Perimeter Road and Site 7 Station Landfill and along the southern boundary of NAVWPNSTA Seal Beach. Site 4 AOPCs 1A and 2A were identified as containing several potential locations where elevated lead was detected.

Site 4, Oil on Roads, consists of Perimeter Road and adjacent areas that extend around NAVWPNSTA Seal Beach for a total length of about 12 miles. It encompasses segments of road adjacent to the Orange County Flood Control Channel north of Edinger Avenue and west of Bolsa Chica Street, two segments of road parallel to and directly north and south of Westminster Avenue, a segment of road south of U. S. Interstate 405, and a segment of road east of Seal Beach Boulevard. The southwesternmost portion of the segment, along Edinger Avenue, is located adjacent to the National Wildlife Refuge (NWR) and the Site 7 Station Landfill. From the mid-1960s to 1973, about one to three times per year, the perimeter roads of the facility were sprayed with unknown quantities of waste oil for dust control. From 1972 through 1973, the waste oils were sprayed by a contractor and were generated by off-facility crude oil operations, petroleum refineries, and oil spills. This EE/CA addresses the implementability, effectiveness, and cost of mitigating potential impacts emanating from Site 4 AOPCs 1A and 2A and addresses applicable regulatory requirements. The Department of the Navy (DON), with state regulatory oversight, is the lead agency for the mitigation of environmental impacts from Site 4 AOPCs 1A and 2A. As the lead agency, DON has final approval authority of the recommended alternative selected and overall public participation activities with state concurrence. DON is working in cooperation with DTSC, California Regional Water Quality Control Board (RWQCB) Santa Ana Region, and U.S. Fish and Wildlife Service (USFWS) in the implementation of this removal action.

A removal action for Site 4 AOPCs 1A and 2A is being conducted because lead "hot spots" were detected in soil with concentrations that are an ecological concern (BNI, 2001b). The Navy decided that the removal action for Site 4 AOPCs 1A and 2A would be included with the Site 7 removal action because the lead-contaminated soil hot spots are adjacent to Site 7 Station Landfill.

This Addendum along with the *Site 7 EE/CA* will be used as the basis for a future CERCLA removal action and is issued in accordance with the Community Relations Plan prepared for NAVWPNSTA Seal Beach to facilitate public involvement in the decisionmaking process.

However, there are some aspects of Site 4 AOPCs 1A and 2A that are similar to Site 7 and overlap, such as the facility location and background, physical characteristics and regulatory requirements, therefore only information and background related to Site 4 are discussed in this Appendix.

A joint Site 4 AOPCs 1A and 2A and Site 7 Action Memorandum (AM) on the selected removal actions will be prepared based on this Addendum, incorporating regulatory and public comments. The AM would provide a written record of the decision to select the appropriate removal actions at Sites 4 and 7. As the primary decision document, the AM substantiates the need for a removal action, identifies the proposed action, and explains the rationale for the removal action selection. A RAP or RAW will be incorporated into the AM.

F2. Site Characterization

This section includes descriptions of the Site 4 Area and background, previous investigations, nature and extent of contamination, analytical data, and risk-screening evaluation for Site 4. The information for this site characterization was taken from various sources as listed in Section F2.2. General background information for the NAVWPNSTA Seal Beach and Site 7 Station Landfill is discussed in the *Site 7 EE/CA*.

F2.1 Facility Description and Background

Site 4 is within the boundaries of NAVWPNSTA Seal Beach (Figure F2-1), located about 30 miles south of the Los Angeles urban center, consists of about 5,000 acres of land located on the Pacific Coast within the City of Seal Beach in Orange County, California.

F2.1.1 Site Location

Site 4 consists of the Perimeter Road and adjacent areas that extend around NAVWPNSTA Seal Beach for a total length of about 12 miles. It encompasses segments of road adjacent to the Orange County Flood Control Channel north of Edinger Avenue and west of Bolsa Chica Street, two segments of road parallel to and directly north and south of Westminster Avenue, a segment of road south of U. S. Interstate 405, and a segment of road east of Seal Beach Boulevard. The southwesternmost portion of the segment, along Edinger Avenue, is located adjacent to the Seal Beach National Wildlife Refuge (NWR) and the Site 7 Station Landfill and is designated as an AOPC (Figure F2-1). This Addendum specifically addresses Site 4 AOPCs 1A and 2A that extend northward about 100 feet from Perimeter Road (Figure F2-2).

F2.1.2 Type of Facility and Operational Status

From the mid-1960s to 1973, about one to three times per year, the perimeter roads of the facility were sprayed with unknown quantities of waste oil for dust control. Weeds on the unpaved roads and nearby fields were cropped and disked for fire control (NEESA, 1985). The oil was then sprayed over the area and disked into the soils for dust control. The waste oil used was generated by the facility and included Bunker C fuel oil. From 1972 through 1973, an estimated 40,000 gallons of waste oil, generated by off-facility crude oil operations and petroleum refineries and from oil spills, were sprayed by a contractor in two or three applications on approximately 12 miles of roadway. The oil was applied in dry weather to minimize the possibility of transport in surface runoff (SWDIV, 1990b). Offsite contracting of waste oil was discontinued when elevated lead content and trace amounts of other metals were found in the oils (Kearney, 1989). Since early 1974, the perimeter roads have been sprayed with quality-controlled penetrating oil consisting of 70 percent water and 30 percent emulsified agent (NEESA, 1985).

F2.1.3 Topography/Structures

Site 4 AOPCs 1A and 2A are a relatively narrow, linear area (approximately 5,400 feet of a 100-foot wide area). Site 4 AOPC 1A is located within the NWR and AOPC 2A is located east of the NWR. The overall topography of Site 4 mimics that of the station. The road is situated on a gently inclined topographic surface that drains to the southwest (toward the salt marsh). However, locally, the road surface is graded to drain onto NAVWPNSTA Seal Beach. The southern portion of the site has been raised slightly to prevent tidal inundation. Field observations of the tidal flooding of the AOPCs suggest that groundwater in this area is shallow (generally assumed to be less than 10 feet below ground surface [bgs]) (BNI, 2001a). A grade difference of about 2 to 4 feet exists between the lower accumulation areas north of the road portions of Site 4 AOPCs 1A and 2A and the road itself.

F2.1.4 Geology/Soil Information

A description of the geology of NAVWPNSTA Seal Beach and Site 7, including soil, groundwater, and surface water, is provided in the *Site 7 EE/CA* and descriptions related to Site 4 are provided below.

Site 4 is situated in an area that is reportedly underlain by Recent alluvial and coastal deposits (Morton and Miller, 1981). Additionally, lesser amounts of fill are present on some areas of Site 4 (BNI, 2001a). Based on soil borings collected for the RSE, there is indication of possible fill materials beneath portions of AOPCs 1A and 2A.

The depth of groundwater at Site 4 AOPCs 1A and 2A is estimated to range from less than 1 foot to 3 feet bgs. The specific depth to groundwater depends on a number of fluctuating conditions such as tides, seasons, and the specific location within Site 4 AOPCs 1A and 2A.

F2.1.5 Surrounding Land Use and Populations

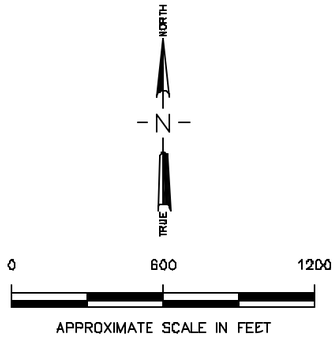
The surrounding land use and populations at Site 4 AOPCs 1A and 2A are similar to that of Site 7 and are described in the *Site 7 EE/CA*.

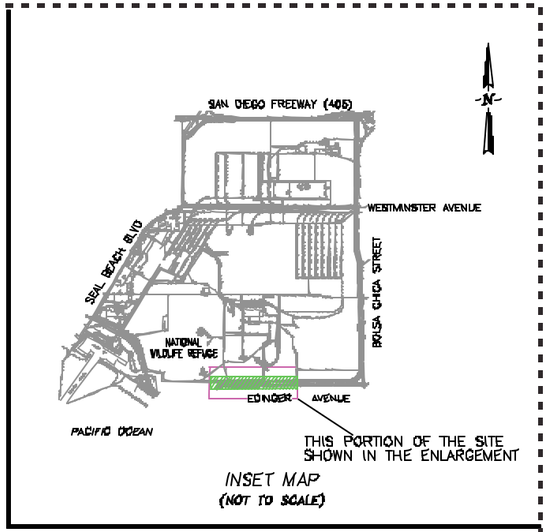
Similar to Site 7, water is supplied to NAVWPNSTA Seal Beach by the city of Seal Beach by a gravity-fed distribution system. Groundwater under NAVWPNSTA Seal Beach currently is not used for drinking purposes on-station. Nonpotable water used for agricultural purposes is supplied by on-station agricultural wells with screened intervals between 140 and 600 feet bgs. Because of the distance of these wells from the site (with the closest well nearly 5,000 feet north of Site 4) and the depths of their screen intervals, Site 4 is not expected to impact the water quality in these wells.

No regular NAVWPSTA Seal Beach activities take place at Site 4, except intermittent use of Perimeter Road by security military personnel or to access the NWR. There are no buildings or structures present.

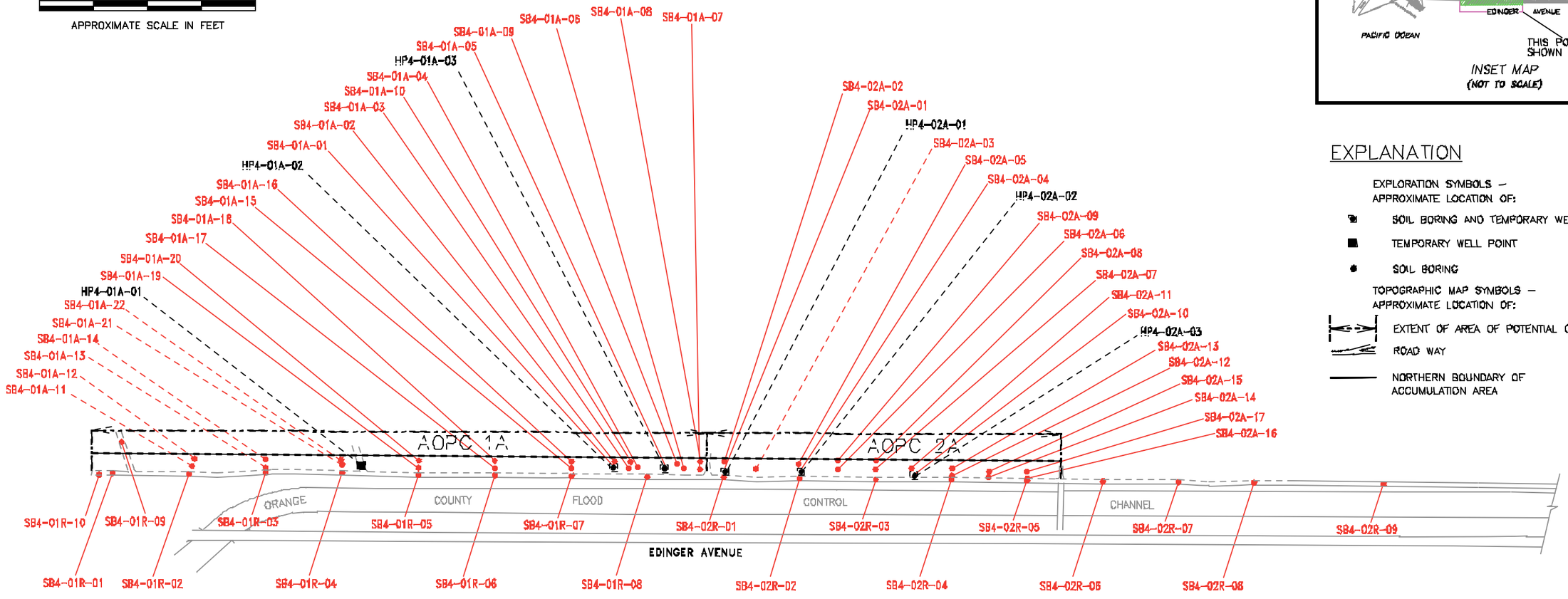
Figure F2-1

This detailed station map has been deleted from the Internet-accessible version of this document as per Department of the Navy Internet security regulations.





INSET MAP
(NOT TO SCALE)



EXPLANATION

EXPLORATION SYMBOLS –
APPROXIMATE LOCATION OF:

- SOIL BORING AND TEMPORARY WELL POINT
- TEMPORARY WELL POINT
- SOIL BORING

TOPOGRAPHIC MAP SYMBOLS –
APPROXIMATE LOCATION OF:

- EXTENT OF AREA OF POTENTIAL CONCERN (AOPC)
- ROAD WAY
- NORTHERN BOUNDARY OF ACCUMULATION AREA

Source: Final Removal Site Evaluation Report,
Installation Restoration Program Sites 4, 5, and 6.
Bechtel National, Inc., 2001

Figure F2-2
Sampling Locations at Site 4 Oil on Roads
NAWPNSTA Seal Beach
Site 4 AOPCs 1A and 2A EE/CA

CH2MHILL

F2.1.6 Sensitive Ecosystems

Approximately 911 acres of NAVWPNSTA Seal Beach, including almost all of the saltwater marsh, is included in the NWR. The ecological habitats at the station include open water, tidal channels, mud flats, and salt marshes of Anaheim Bay. The main purpose of the NWR is to preserve and enhance the area's living resources. Scientific investigations have been and are being conducted on the NWR. Limited recreational activities are authorized for military and civilian personnel (retired military). Because Site 4 AOPCs 1A and 2A are adjacent to Site 7, the sensitive ecosystem at Site 4 is similar to that of Site 7. The sensitive ecosystem consists of sensitive species of organisms, plants, birds, and mammals. Descriptions of the sensitive ecosystem are provided in the *Site 7 EE/CA*.

The vegetative community at Site 4 AOPC 1A has been characterized as predominantly coastal salt marsh/mudflat and AOPC 2A has been characterized as predominantly annual grassland (Recon, 1997). The following sensitive plant species have been observed at Site 4: Southern tarplan (*Hemizonia parryi* ssp. *Australis*) and Seaside calandrinia (*Calandrinia maritima*) (Recon, 1997).

Mammals observed at Site 7, which is directly north of Site 4, include the house mouse and western harvest mouse, the blacktail hare, cottontail, and California vole (SWDIV, 1999). Birds sighted at Site 7 include the mourning dove, barn owl, California least tern, Forster's tern, rock dove, Cooper's hawk, red-tailed hawk, turkey vulture, northern mockingbird, western meadowlark, and the Belding's Savannah sparrow, which nests throughout Site 7. Two species of federally listed endangered birds, the California least tern and the light-footed clapper rail, rely on the Seal Beach NWR tidal salt marsh habitat for their nesting grounds.

F2.2 Previous Actions and Investigations

NAVWPNSTA Seal Beach and the DON have been actively engaged in the IR Program since 1980.

Since 1973, Site 4 has been the subject of 10 environmental investigations/reports. Not all of the following investigations/reports dealt directly with AOPCs 1A and 2A of Site 4. It was not until the Removal Site Evaluation (RSE) that AOPCs 1A and 2A were separately designated within Site 4.

- *Environmental Impact Assessment (EIA) – Weed and Dust Control* (NAVWPNSTA, 1973)
- *Initial Assessment Study (IAS) of NWS Seal Beach* (NEESA, 1985)
- *Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA)* (A.T. Kearney, 1989)
- *Seal Beach Laboratory Testing* (SWDIV, 1990a)
- *Addendum to the Preliminary Assessment* (IAS) (NEESA, 1990)
- *Initial Site Inspection (SI)* (SWDIV, 1990b)
- *Remedial Investigation of Site 7* (SWDIV, 1995a)

- *Confirmation Testing for Operable Unit (OU)-6 and OU-7, Technical Memorandum* (SWDIV, 1995b)
- *Analytical Results for Soil Samples Collected in 1995 from IR Site 4* (AccuTek, 1995)
- *Removal Site Evaluation (RSE) Report for Installation Restoration Program Sites 4, 5, and 6* (BNI, 2001a)

The following discussion briefly summarizes the results of previous environmental investigations conducted at Site 4.

F2.2.1 Environmental Impact Assessment

In 1973, a plan was proposed to control weed growth on NAVWPNSTA Seal Beach property and fugitive dust emissions from base roads by applying an oil/water mixture in accordance with RWQCB waste discharge requirements. This oil/water application on Perimeter Road was later identified as Site 4 and investigated under the IR Program (NAVWPNSTA Seal Beach, 1973).

F2.2.2 Initial Assessment Study

In 1985, the Navy conducted an IAS to investigate potentially contaminated sites at NAVWPNSTA Seal Beach (NEESA, 1985). The IAS was conducted under the Navy Assessment and Control of Installation Pollutants (NACIP) Program by the Naval Energy and Environmental Support Activity (NEESA). NACIP was the predecessor program to the Navy's IR Program. NEESA was later renamed Naval Facilities Engineering Services Center (NFESC). The IAS concluded that 9 of the 25 impacted sites identified at NAVWPNSTA Seal Beach posed a potential threat to human health or the environment and were sufficient to warrant further investigation. Site 4 was identified as one of the nine sites, and a confirmation study was recommended because it was not known if the oil sprayed on the perimeter roads contained polychlorinated biphenyls (PCBs) or pesticides. It was recommended that soil samples be collected at a depth of 12 inches bgs (NEESA, 1985).

F2.2.3 RCRA Facility Assessment

In 1989, A.T. Kearney, Inc., performed an RFA of NAVWPNSTA Seal Beach for EPA. The purpose of the RFA was to assess whether there had been, or were likely to be, releases of hazardous substances from locations where hazardous wastes or materials were or had been used, treated, stored, or disposed. The assessment was based on historical information, interviews with NAVWPNSTA Seal Beach personnel, visual inspections of the sites, and preliminary review of data available from the ongoing SI of the nine sites. The RFA identified 69 solid waste management units (SWMUs) and Areas of Concern (AOC). Many of these SWMUs and AOCs were the same as IR Program sites identified by the 1985 IAS. The RFA concluded that Site 4 has a high current and ongoing potential for the release of hazardous wastes or constituents to the soil or groundwater and for the generation of subsurface gases (Kearney, 1989).

F2.2.4 Seal Beach Laboratory Testing

In January 1990, soils in agricultural outlease area where there was concern that PCB-contaminated oil may have been used for weed suppression were sampled for priority

pollutants. No priority pollutants were detected at levels exceeding toxic threshold limit concentrations (TTLCs) in soils or water sampled (SWDIV, 1990a).

F2.2.5 Addendum to the Preliminary Assessment

In August 1990, California DTSC (Department of Health Services [DHS] at that time) requested that the findings of the IAS be verified and that all 25 initial sites be considered for further investigation, plus other potential sites identified at NAVWPNSTA Seal Beach. Study was undertaken, again without sample collection, but with additional information provided by the RFA report, RI Verification Step Data, and other information found in Navy files. In addition to the original 25 sites identified in the IAS (Sites 1 through 25), 17 new sites were identified (Sites 35 through 51). Several sites recommended for no further action (NFA) in the IAS also were recommended for further study in the Addendum to the Preliminary Assessment (NEESA, 1990).

F2.2.6 Initial Site Inspection

In 1990, as part of the initial SI, a total of 21 (20 samples collected along the road/road shoulder and 1 background sample) soil samples were collected at a depth of 12 inches and analyzed for metals, semivolatile organic compounds (SVOCs), pesticides, PCBs, and polychlorinated dibenzodioxins/polychlorinated dibenzofurans (PCDDs/PCDFs). Field-screening for gamma radiation and organic vapors was also conducted. Radiation levels ranged between 10 and 16 microroentgen. The organic vapor analyzers detected no organic vapors (SWDIV, 1990b).

Analytical results of soil samples collected during the SI indicated the presence of arsenic; lead; 4,4'-dichlorodiphenyltrichloroethane (DDT); and octachlorodibenzo-p-dioxin (OCDD) at slightly elevated levels in most samples. The SI report recommended no further investigation for Site 4 based on the absence of heavy metals, PCBs, and PCDDs/PCDFs at levels considered to be hazardous to the environment and the fact that oil biodegrades naturally (SWDIV, 1990b). A review of the SI soil data indicated two samples exceeding the preliminary remediation goal (PRG) (EPA, 1996) value for 4,4'-DDT, and five samples with PCDDs/PCDFs toxicity equivalency factor (TEF) values exceeding the residential PRG value for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). Arsenic concentrations were above the estimated NAVWPNSTA Seal Beach upper-limit background value (ULBV) for arsenic of 15.38 mg/kg in soil (BNI, 2001a).

F2.2.7 Remedial Investigation

As part of the investigations for the initial SI at Site 7 (Station Landfill), the presence of elevated lead concentrations (2,080 mg/kg) was detected in soil at a depth of 1 foot bgs at the location of well W-42, near the segment of Site 4 that is adjacent to the NWR. Additional investigation was conducted in this area (designated as the "lead hot spot") as part of the Remedial Investigation for OUs 1, 2, and 3. Thirty-five surface-soil samples were field-analyzed for chromium, lead, and zinc. In 1993, results for 23 of these soil samples indicated the presence of lead concentrations in excess of the California-modified residential PRG for lead (130 mg/kg) with a maximum concentration of 5,180 mg/kg. These samples were located in a strip of land approximately 100 by 1,400 feet along Perimeter Road in the southern part of Site 7. For confirmation purposes, five surface-soil samples were collected from the

lead hot spot and analyzed at an offsite fixed, commercial laboratory. Analytical results indicated the presence of elevated lead concentrations with a maximum concentration of 740 mg/kg. Tetrachloroethene, benzo(a)pyrene, and 4,4'-DDT were each reported in one sample. Total petroleum hydrocarbons as diesel (TPHd) concentrations of 40.9 and 19.8 mg/kg were also reported in two sample locations. No chemicals of potential concern (COPCs) were identified in the groundwater samples collected from well W-42 located within the lead hot spot. The RI report concluded that the elevated lead concentrations reported in the lead hot spot were probably associated with oiling of Perimeter Road rather than Site 7 operations; therefore, the lead hot spot would be further addressed as part of Site 4 (SWDIV, 1995a).

F2.2.8 Confirmation Testing for OU-6 and OU-7, Technical Memorandum

In February 1995, out of 35 locations included in OU 6 and OU 7, 29 locations were recommended for NFA, and 6 locations were recommended for further investigation during the SI. The six locations recommended for the SI were AOC 4, Oil on Roads (Site 4); AOC 6, External Paint Area (Building 246); AOC 7, Railroad Supply Yard (Building 438); SWMU 11, Quenching Water Disposal Area (Building 307); SWMU 56, Hazardous Waste Drum Storage (Building 246); and SWMU 57, Paint Locker Area (Building 59). Site 4 was not sampled during this study because it was, "too large for confirmation testing and potential exists for release harmful to human health and the environment." Therefore, Site 4 was recommended for the SI (SWDIV, 1995a).

F2.2.9 Analytical Results for Soil Samples Collected in 1995 from IR Site 4

In 1995, the DON contracted AccuTek to collect soil samples every 250 feet (426 samples) along Perimeter Road at depths of 6 and 24 inches bgs and analyze them for lead. Soil samples collected every 500 feet (212 samples) were analyzed for total recoverable petroleum hydrocarbons (TRPHs) and SVOCs. Soil samples collected every 1,000 feet (106 samples) were analyzed for PCDDs/PCDFs. Analytical results indicated that 36 out of 426 samples at the 6-inch depth had lead concentrations above the residential PRG (rPRGs) value of 130 mg/kg. The analytical results also indicate 25 samples had PCDD/PCDF toxicity equivalency factor values above the PRG value for TCDD of 0.0038 mg/kg, 17 of which were from a depth of 6 inches bgs and 8 of which were from a depth of 24 inches bgs. The only SVOC reported above the rPRG was benz(a)anthracene, in one sample at the 6-inch depth (AccuTek, 1995).

F2.2.10 Removal Site Evaluation for IRP Sites 4, 5, and 6

In 2001, an RSE was conducted to evaluate supplemental data obtained during previous site investigations at Sites 4, 5, and 6. It is in this RSE that Site 4 was separated into 12 AOPCs including AOPCs 1A and 2A. The COPCs were identified for soil and groundwater, and the concentrations above the screening criteria were assessed. The COPCs for soil were evaluated for fate and transport to reach the groundwater. A human health risk assessment (HHRA) and an ecological risk assessment (ERA) were conducted.

Based on the findings and conclusions for soil at AOPCs 1A and 2A, further evaluation is recommended for lead in soil. Based on the findings and conclusions for groundwater at AOPCs 1A and 2A, groundwater is recommended for further evaluation in the form of

confirmatory groundwater monitoring for arsenic, antimony, and hexavalent chromium (BNI, 2001a). Groundwater monitoring for Site 4 AOPCs 1A and 2A is included in the Groundwater Monitoring Program at Installation Restoration Sites 4, 5, 6, and 7 (BNI, 2002).

F2.3 Source, Nature, and Extent of Contamination

The source, nature, and extent of contamination at Site 4 AOPCs 1A and 2A are discussed in this section. The information presented summarizes the results of the previous investigations.

Site 4 consists of Perimeter Road and adjacent areas that extend around NAVWPNSTA Seal Beach for a total length of about 12 miles. From the mid-1960s to 1973, about one to three times per year, the perimeter roads of the facility were sprayed with unknown quantities of waste oil for dust control. Offsite contracting of waste oil was discontinued when elevated lead content and trace amounts of other metals were found in the oils (Kearney, 1989). Site 4 is situated in an area that is reportedly underlain by recent alluvial and coastal deposits (Morton and Miller, 1981). Additionally, lesser amounts of fill are present on some areas of Site 4 (SWDIV, 2001a). Based on soil borings collected for the RSE, there is indication of possible fill materials beneath portions of AOPCs 1A and 2A.

Figure F2-2 shows the locations that were sampled for the RSE investigation. Soil samples were collected and analyzed to characterize and delineate the lateral and vertical extent of the COPCs. Eight soil borings were hand-augered at each AOPC at depths from 0 to 1 foot bgs and 2 to 2.5 feet bgs. Step-out soil samples also were collected as necessary to define the lateral and vertical extent of COPCs. Three groundwater samples were analyzed for the COPCs from AOPCs 1A and 2A.

Soil samples were analyzed for target analyte list (TAL) metals, polynuclear aromatic hydrocarbons (PAHs), PCBs, and PCDDs/PCDFs. The groundwater samples and some soil samples were also analyzed for hexavalent chromium. Results are presented in Section 2.4.

At Site 4 AOPCs 1A and 2A, shallow groundwater is estimated to range from less than 1 foot to 3 feet bgs. The specific depth to groundwater depends on a number of fluctuating conditions such as tides, seasons, and specific location within Site 4 AOPCs 1A and 2A. The underlying shallow groundwater is saline to hypersaline (TDS ranging from 29,600 to 57,800 mg/L) and reasonably cannot be regarded as a potential drinking water source. A connection between the shallow groundwater and the lower aquifer system (deeper main drinking water source) appears to be unlikely as presented in the site discussion above (BNI, 2001a).

F2.4 Analytical Data

This section discusses the analytical results of COPCs detected at Site 4 AOPCs 1A and 2A and summarizes the data quality.

F2.4.1 Presentation of Analytical Data

Analytical data associated with Site 4 AOPCs 1A and 2A include:

- *Initial SI* (SWDIV, 1990b)
- *Remedial Investigation* (SWDIV, 1995a)
- *Final Removal Site Evaluation Report for Installation Restoration Program Sites 4, 5, and 6, Naval Weapons Station Seal Beach, California, October.* (BNI, 2001a)

Site 4 AOPCs 1A and 2A analytical data summaries from these reports are presented in Attachment B.

F2.4.2 Data Quality

A description of the quality assurance/quality control (QA/QC) procedures and specific discussion of data quality are included in each document, which contain analytical results from previous investigations. In general, the information contained in these documents was found to be of acceptable quality to adequately describe site conditions. All data collected were validated by an outside, independent validator in accordance with NEESA (now known as NFESC) guidelines.

F2.5 Risk Evaluation

This section summarizes the potential risk to human health or the environment from lead-contaminated soil at Site 4 AOPCs 1A and 2A.

F2.5.1 Risk Evaluation Findings

Two risk assessments have been performed using data collected from Site 4 AOPCs 1A and 2A. They include a human health and ecological risk assessments as part of the RSE (BNI, 2001a), and a proposed site-specific target cleanup goal for lead assessment (CH2M HILL, 2003b).

F2.5.1.1 RSE Human Health and Ecological Risk Assessment

Site 4 AOPC 1A

For AOPC 1A, there were several metals reported at concentrations above statistical background in soil adjacent to the road. There were also elevated dioxin/furan concentrations reported in soil adjacent to the road. No human health risk assessment was performed for AOPC 1A because it is located within the NWR. Additionally, there would not be any development on AOPC 1A due to its location next to a former landfill, location in the NWR, and its location within the explosive arc at NAVWPNSTA Seal Beach.

Further evaluation was recommended for AOPC 1A for soil and confirmatory groundwater monitoring for antimony and hexavalent chromium. The ERA in the RSE suggested that the concentrations of the COPCs in soil were not ecologically significant when compared to background conditions and the range of TRVs. However, DTSC would not concur with NFA for the soil due to the presence of elevated lead concentrations at a few locations. Groundwater chemical concentrations are not expected to adversely affect marine life, so only confirmatory monitoring was recommended.

Site 4 AOPC 2A

For AOPC 2A, there were metals, dioxin/furan, and Aroclor 1254 concentrations reported in soil adjacent to the road. A human health risk assessment was performed for AOPC 2A. The incremental cancer risk was estimated at 3.7×10^{-5}, which is within the NCP generally acceptable range of 10^{-6} to 10^{-4} for risk management. The systemic toxicity was evaluated to be unlikely due to a hazard index (HI) less than 1.0. There are potential adverse health effects from exposure to lead; however, this is not of a concern since residential use of AOPC 2A is unlikely due to its location next to a former landfill, its proximity to the NWR, and its location within the explosive arc at NAVWPNSTA Seal Beach. Additionally, human presence is usually limited to brief visits by USFWS personnel and Navy security personnel due to its location next to the NWR.

Further evaluation was recommended for AOPC 2A for soil and confirmatory groundwater monitoring for antimony, arsenic, and hexavalent chromium. The ERA in the RSE suggested that the dioxin/furan concentrations in soil were of minor ecological significance and the COPC concentrations in soil were not ecologically significant when compared to background conditions and the range of TRVs. However, DTSC would not concur with NFA for the soil due to the presence of elevated lead concentrations at a few locations. Groundwater chemical concentrations are not expected to adversely affect marine life, so only confirmatory monitoring was recommended.

F2.5.1.2 Proposed Site-Specific Target Cleanup Goal for Lead at Site 4 AOPCs 1A and 2A

To guide soil removal action activities at Site 4 AOPCs 1A and 2A, a site-specific target cleanup goal (TCG) for lead was developed. The site-specific TCG is a level specific to Site 4 AOPCs 1A and 2A that represents concentrations of lead that will preserve the desired attributes of the assessment endpoints, and below which, adverse effects levels are expected either to be absent or to be within the limits of effects levels for the wildlife populations (i.e., less than a 20 percent effect). The site-specific TCG was derived based on a comparison of the back-calculated lowest observed adverse effect level (LOAEL)-equivalent soil concentrations for each of four bird and mammal receptors (harvest mouse, ground squirrel, skunk, and robin) against the distribution of lead in the soil at Site 4 AOPCs 1A and 2A.

LOAEL-equivalent soil concentrations for the four bird and mammal receptors were determined by the back-calculation of the following exposure model:

$$E_j = [Soil_j * P_s * FIR] + [\sum_{i=1}^{N} B_{ij} * P_i * FIR] * AUF$$

Where:

E_j	=	total exposure (mg/kg/day)
$Soil_j$	=	concentration of chemical in soil (mg/kg)
P_s	=	soil ingestion rate as a proportion of diet
FIR	=	total food ingestion rate for the representative species (kg food/kg body weight/day)

B_{ij} = concentration of chemical (j) in biota type (i) (mg/kg)

P_i = proportion of biota type (i) in diet

AUF = area use factor

LOAEL-equivalent soil concentrations and information used in the calculations are presented in Table F2-1. The LOAEL toxicity reference valves (TRVs) were developed from Kimmel et al. (1980), Grant et al. (1980), and Fowler et al. (1980) for mammals, and from EFA-West (1998) for birds. Lead concentrations in foods consumed by receptors were estimated using bioaccumulation models from Efroymson et al. (2001) and Sample et al. (1999) for plants and soil invertebrates, respectively. Receptor-specific life-history parameters (e.g., diet, soil and food ingestion, area use factors) were either site-specific or derived from the literature (see Table F2-1). LOAEL-equivalent soil concentrations ranged from 459 mg/kg for the harvest mouse to 5,270 mg/kg for the skunk.

To determine the site-specific TCG, the range of LOAEL-equivalent soil concentrations was compared to the full distribution of lead measured in soils in Site 4 AOPCs 1A and 2A (Figure F2-3). Evaluation of the distribution of lead concentrations in Site 4 AOPCs 1A and 2A indicates they are highly skewed and dominated by relatively few samples with high concentrations (i.e., hot spots). These hot spots were identified in a narrow strip along Perimeter Road and had lead concentrations that ranged from about 900 mg/kg to over 7500 mg/kg in soils. Despite these high concentrations, these values represent only 11 of 64 samples collected from these two AOPCs combined. Moreover, the median lead concentrations were 42 and 61 mg/kg for Site 4 AOPCs 1A and 2A, respectively (Figure F2-3) indicating that these few high concentrations were heavily influencing the mean.

Based on a visual evaluation of the observed lead distribution in Site 4 AOPCs 1A and 2A and in light of the calculated LOAEL-equivalent soil concentrations, a site-specific TCG of 600 mg/kg for lead is proposed. This is in addition to an area-wide arithmetic average TCG of less than 100 mg/kg for lead in soils for Site 4 AOPCs 1A and 2A. This level represents a clear break point in the distribution of lead concentrations at the two AOPCs (Figure F2-3) and represents a concentration that would eliminate the majority of risk to wildlife receptors. The highest and next highest lead concentrations remaining in AOPC 1A following remediation will be 554 and 398 mg/kg, respectively, the highest concentration remaining in AOPC 2A will be 391 mg/kg. Only the 554 mg/kg concentration exceeds the lowest LOAEL-equivalent soil concentration. Lead concentrations in all other samples that will remain following remediation will be below the lowest LOAEL-equivalent soil concentration. Thus, remediation to a maximum TCG of 600 mg/kg for lead with an area-wide arithmetic average TCG of less than 100 mg/kg for lead is expected to virtually eliminate risks from lead to wildlife in Site 4. This TCG was not developed to be protective of human health because human access to Site 4 AOPCs 1A and 2A is limited. Because of the NWR, human presence is usually limited to brief visits by USFWS personnel and Navy security personnel. Additionally, there would not be any development on Site 4 AOPCs 1A and 2A due to its location next to a former landfill, proximity to the NWR, and its location within the explosive arc at NAVWPNSTA Seal Beach. This site-specific TCG is below the industrial PRG (EPA, 2002) for lead, which is 750 mg/kg.

TABLE F2-1. Calculation Site-Specific Lead Target Cleanup Goals for Site 4 AOPCs 1A and 2A

Species	FIR	SIR	Pplant	Pinvert	Pmam	Area Use Factor (AUF)		NOAEL TRV	LOAEL TRV	Estimated concentrations in site biota (mg/kg dry weight)				Estimated Exposure (mg/kg/d)				Total Exposure adjusted for Site Use	NOAEL HQ	LOAEL HQ	TCGs
										Small Mammals	Plants	Soil Invertebrates	Soil	Small Mammals	Plants	Soil Invertebrates	Total				
	kg/kg/d	prop. FIR	prop. FIR	prop. FIR	prop. FIR	Area	Time														
Harvest Mouse	0.169	0.02	0.9	0.1	0	1	1	0.92	4.7	12.988	8.251	113.077	1.547	0.000	1.251	1.905	4.703	4.703	5.11	1.00	459.0
Ground Squirrel	0.041	0.05	0.6	0.35	0	1	1	0.92	4.7	17.880	11.664	186.049	1.743	0.000	0.287	2.669	4.698	4.698	5.11	1.00	850.6
Skunk	0.053	0.05	0.35	0.4	0.2	0.147	1	0.92	4.7	45.998	32.448	810.630	13.848	0.483	0.597	17.041	31.970	4.700	5.11	1.00	5270.0
Robin	0.206	0.02	0.44	0.54	0	0.286	0.5	0.014	8.75	31.082	21.226	440.212	10.197	0.000	1.926	49.010	61.133	8.742	624.43	1.00	2473.0

TCGs - target cleanup goals
FIR - food ingestion rate
SIR - soil ingestion rate
Pplant - proportion of plant material in the diet
Pinvert - proportion of invertebrates in the diet
Pmam - proportion of vertebrates or small mammals in the diet
prop. FIR - proportion of food ingestion rate
TRV - toxicity reference value
NOAEL - no observed adverse effect level
LOAEL - lowest observed adverse effect level
HQ - hazard quotient

Notes:
1) Food ingestion rates (FIR) from BNI (2001)
2) Soil ingestion from BNI (2001) except for robin which was from Sample and Suter (1994)
3) Diet composition from BNI (2001) for ground squirrel and skunk. Diet for harvest mouse based on Webster and Jones (1982). Diet for robin based on annual mean from EPA (1993).
4) AUF based on area was the sum of area of Site 4 AOPCs 1A and 2A divided by home range reported in BNI (2001) for skunk and robin.
5) AUF- time: Mouse, squirrel and skunk assumed to be resident. Individual robins assumed to be migratory - although birds may be found at site year-round, individuals only spend 1/2 of year on site
6) Mammal TRVs from Kimmel et al. (1980), Grant et al. (1980), and Fowler et al. (1980). Avian TRVs from EFA-West (1998).
7) Small mammal bioaccumulation estimated using herbivore model from Sample et al. (1998).
8) Plant bioaccumulation estimated using model from Efroymson et al. (2002).
9) Soil invertebrate bioaccumulation estimated using earthworm model from Sample et al. (1999)
10) Species-specific PRG calculated based on LOAEL

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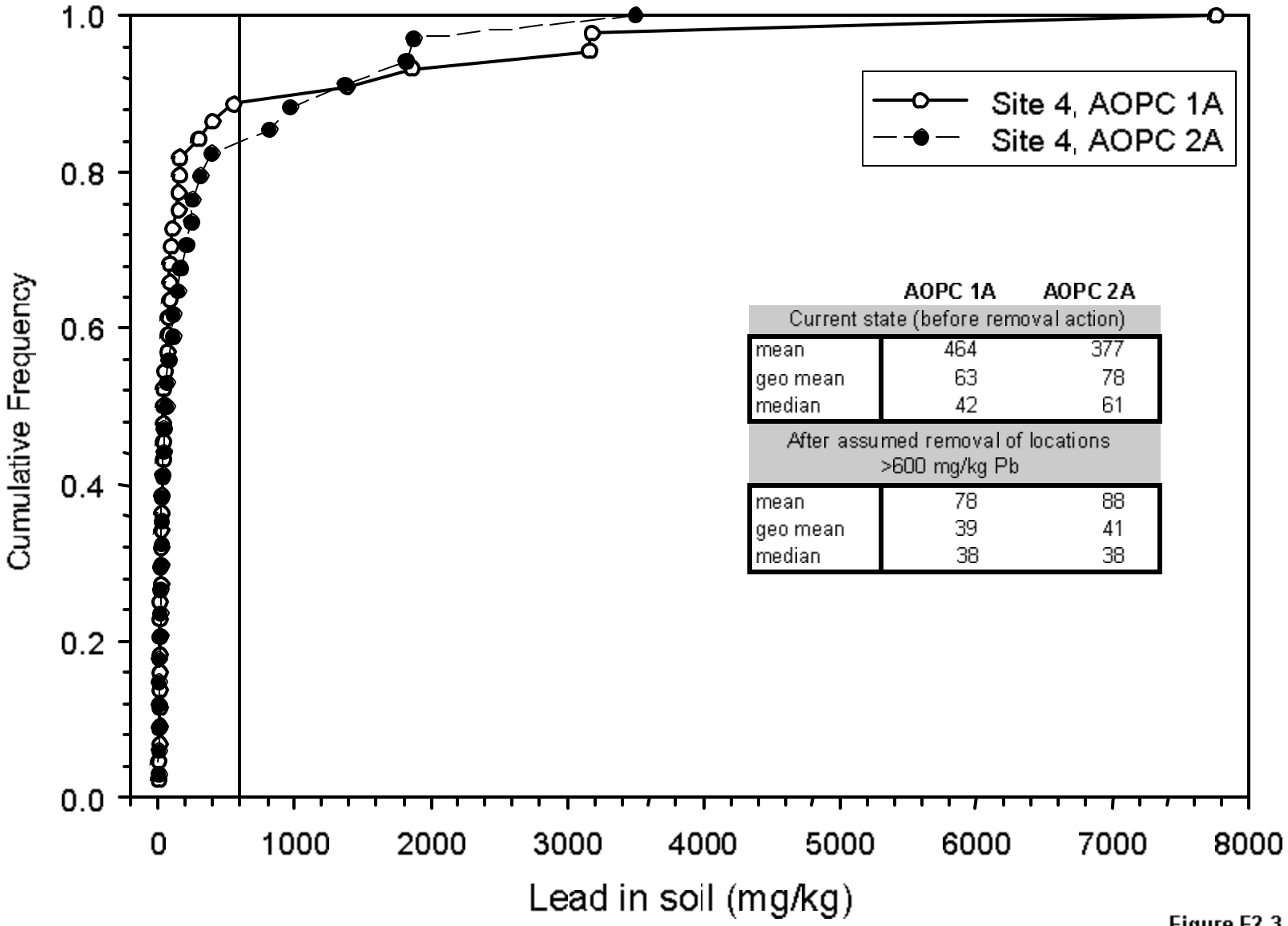

	AOPC 1A	AOPC 2A
Current state (before removal action)		
mean	464	377
geo mean	63	78
median	42	61
After assumed removal of locations >600 mg/kg Pb		
mean	78	88
geo mean	39	41
median	38	38

Figure F2-3
Distribution of Lead in Soil at Site 4 Oil on Roads
NAVWPNSTA Seal Beach
Site 4 AOPCs 1A and 2A EE/CA

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A site-specific TCG of 600 mg/kg for lead is less than the LOAEL-equivalent soil concentrations calculated for ground squirrels, skunks, and robins and only somewhat greater than the LOAEL-equivalent soil concentration for harvest mice (459 mg/kg). Additionally, removal of locations with 600 mg/kg or more of lead at the two AOPCs would decrease the arithmetic mean lead concentrations from 464 to 78 mg/kg at AOPC 1A and from 377 to 88 mg/kg at AOPC 2A (Figure F2-3). The resulting mean lead concentrations are far below the LOAEL-equivalent soil concentrations for all four species and indicate that the site-specific TCG will provide an effective removal of localized risk from lead. The approach and methods used for the development of the site-specific TCG for lead in Site 4 AOPCs 1A and 2A, plus the final site-specific maximum TCG of 600 mg/kg for lead were presented to and discussed with Human and Ecological Risk Division (HERD) of the California DTSC. The methods, approach, and final site-specific TCG were found to be acceptable to DTSC (DTSC, 2003b).

According to the NCP, eight factors must be considered to determine the appropriateness of a removal action (40 Code of Federal Regulations [CFR] 300.415[b][2]). Of the eight NCP criteria for determining the appropriateness of a removal action, those identified as being applicable for this removal action are:

- Actual or potential exposure to nearby animals or the food chain from hazardous substances or pollutants or contaminants (40 CFR 300.415[b][2][i])
- Actual or potential contamination of sensitive ecosystems (40 CFR 300.415[b][2][ii])

F2.5.2 Health and Environmental Effects Associated with Chemicals of Concern and Threat to Nearby Human Populations and Environment

Based on the RSE findings and conclusions for soil at Site 4 AOPCs 1A and 2A, further evaluation is recommended for lead in soil (BNI, 2001a). General effects to ecological receptors are described below as well as in the *Site 7 EE/CA*.

F2.5.2.1 Lead

Lead can be extremely toxic to a wide variety of organisms. Plants exposed to high concentrations of lead in soils usually exhibit decreases in transpiration rate, weight (e.g., leaves, root, and shoot), and growth (e.g., elongation and biomass). Similarly, lead concentrations in soil can reduce the rate of decomposition by microflora, inhibit soil respiration and other biochemical processes, and reduce nitrogen and carbon mineralization efficiency. In general, invertebrates are more sensitive to lead than fish, but the severity of toxicity is species dependent. For terrestrial invertebrates, such as earthworms, significant amounts of lead exposure may cause impairment to cocoon production, reduced reproductive success (e.g., reduced hatches/cocoon or percent hatches), and decreases in overall growth. For aquatic invertebrates and fish, acute and chronic lead toxicity increases as hardness decreases and can readily cause mortality. The effects of lead on amphibians and reptiles are not very well known, due to lack of research to date. However, it is believed that elevated body burdens of lead in amphibians and reptiles may result in physiological and reproductive effects. Research with mice in the laboratory has implicated lead as a potential carcinogen and an agent for adverse reproductive effects (e.g., reduced offspring weight).

Fish and Aquatic Invertebrates. Eisler (1988) conducted a review and found that several trends are evident concerning lead toxicity in aquatic organisms.

- Dissolved waterborne lead was more toxic than total lead.
- Organic lead compounds were more toxic than inorganic forms.
- Effects were most pronounced at elevated water temperatures and reduced pH after long exposures.
- Younger life stages had more pronounced effects.

Within invertebrates, crustaceans appear to be the most sensitive to lead (Mance, 1990). The LC50/EC50 for various lead compounds to Daphnia magna ranged from 450 to 1,910 parts per million (ppm) and increased with water hardness (EPA, 1980). Reproductive impairment in daphnids was significant with exposure to 10 parts per billion (ppb) lead (Eisler, 1988). Rotifers exposed to lead chloride in relatively soft water had an LC50/EC50 value of 40,800 ppb (EPA, 1980). Snails exhibit significant mortality rates when exposed to lead at 19 ppb over their lifetime (Eisler, 1988).

Chronic lead exposure to fishes can lead to spinal curvature, anemia, darkening of the tail, caudal fin degeneration, reduced swimming ability, enzyme inhibition in various organs, muscular atrophy, paralysis, reduced growth, delay in maturation, and death (Eisler, 1988). One sign of acute toxicity in fishes is increased mucous formation. The excess coagulates over the entire body, particularly the gills, and can result in death from suffocation (Aronson, 1971; NRCC, 1973). Rand and Petrocelli (1985) found that toxic effect levels (48- to 96-hour LC50 or EC50) ranged from 1,000 to 500,000; 20,000 to 400,000; and 2,000 to 500,000 ppb for species of Salmonidae, Centrarchidae, and Cyprinidae, respectively. An LC50 value of 40 mg/L lead was reported for a 96-hour static toxicity test with goldfish (*Carassius auratus*) (Bolognani et al., 1992). LC50 values for rainbow trout (*Oncorhynchus mykiss*) exposed to lead under the static conditions were 471 and 542 mg/L (total) and 1.47 and 1.32 mg/L (dissolved), while the LC50 under flow-through conditions was only 1.17 mg/L (Goettl and Davies, 1976).

In California, the acute ambient water quality values for lead, based on the dissolved fraction, are 65 micrograms per liter (µg/L) at a water hardness of 100 mg/L calcium carbonate ($CaCO_3$) in fresh water and 210 µg/L in saltwater (EPA, 2000). The chronic criteria are 2.5 µg/L and 8.1 µg/L, respectively. For screening purposes, the threshold effects level (TEL) for lead in freshwater sediments is 35.0 mg/kg, and the TEL in marine sediments is 30.2 mg/kg (Buchman, 1999). The probable effects levels (PELs) are 91.3 mg/kg and 112.2 mg/kg for freshwater and marine sediments, respectively. The acute and chronic national ambient water quality criteria (NAWQC) for lead are 0.082 and 0.0032 mg/L at a hardness of 100 mg/L $CaCO_3$ (EPA, 1985).

Bioavailability and Bioaccumulation. Due to strong absorption of lead to soil organic matter, the bioavailability of the lead is limited. Organic compounds of lead are more bioavailable than inorganic lead. Compared to lead carbonate, lead sulfate is relatively soluble and likely to be more bioavailable.

Lead can be bioaccumulated by plants and animals. The primary route of lead exposure to plants is through root uptake; however, translocation to shoots is limited (Wallace, et al., 1977). In aquatic organisms, the highest lead concentrations are usually seen in benthic organisms and algae, whereas the lowest concentrations tend to be evident in upper trophic level predators like carnivorous fish (ATSDR, 1993). Lead is known to bioconcentrate in aquatic biota. Invertebrates exposed to 32 ppb lead had bioconcentration factors (BCFs) of 1,000 to 9,000 over a 28-day period. Median BCF values in aquatic biota exposed to various concentrations of lead varied from about 42 in fish to 2,570 in mussels (EPA, 1985); however, available evidence does not support the occurrence of lead biomagnification through the aquatic food chain (Eisler, 1988). In vertebrates, lead tends to concentrate in bone matter instead of soft tissue, minimizing movement to higher trophic levels and uptake of lead by predators, especially raptors that regurgitate indigestible material (Stansley and Roscoe, 1996).

F2.5.3 Documented Exposure Pathways

There are no documented impacts due to exposure to chemicals in soil at Site 4 AOPCs 1A and 2A. The primary receptors that are most likely to be impacted by Site 4 AOPCs 1A and 2A under existing conditions are ecological receptors that nest in Site 7, which is located directly north of Site 4 AOPCs 1A and 2A.

Site 4 AOPCs 1A and 2A have vegetative and wildlife receptors. If Site 4 COPCs have migrated to the adjacent habitat, potentially complete pathways are present for exposure of representative organisms to COPCs in the soil in the cropland, non-native grassland, southern willow scrub, and coastal salt marsh (BNI, 2001a).

Another possible exposure pathway, though less likely, for chemicals from Site 4 AOPCs 1A and 2A to impact the environment is through groundwater. Groundwater appears to flow predominantly away from the NWR and the coast towards the north and northeast (SWDIV, 1995a). However, during periods of significant rainfall (wet weather conditions), the groundwater at Site 4 may flow towards the NWR. The exact groundwater flow direction is determined by the interaction among hydrologic features at or adjacent to Site 4, including the NWR tidal marsh and the Orange County Flood Control Channel (OCFCC) (SWDIV, 1999b).

Human exposure to Site 4 AOPCs 1A and 2A (especially the areas within the Seal Beach NWR) would be limited. Because wildlife refuges are established to protect wildlife, human presence is usually limited to brief visits by USFWS personnel and Navy security personnel. Additionally, there would not be any development on Site 4 AOPCs 1A and 2A due to its location next to a former landfill, proximity to the NWR, and its location within the explosive arc at NAVWPNSTA Seal Beach.

F2.5.4 Sensitive Populations

Of the eight species of birds that are listed as endangered by either federal or state agencies and are known to occur at NAVWPNSTA Seal Beach and the associated wetlands, the state-listed Belding's Savannah sparrow nests in the upland areas of Site 7 that are about 500 feet directly north of Site 4 AOPCs 1A and 2A. Other species (including the California

least tern and Aleutian Canada goose) have been observed and periodically may visit the site.

The western portion of Site 4, AOPC 1A, lies in the Seal Beach NWR. In general, the NWR should be considered a sensitive ecological habitat because it provides essential habitat for a variety of avian species. Site 4 AOPCs 1A and 2A are only intermittently used for human activities; therefore, humans would not be a sensitive receptor.

F3. Identification of Removal Action Objectives

F3.1 Determination of Removal Scope

The scope of this removal action is to reduce risk to the environment associated with lead-contaminated soil at Site 4 AOPCs 1A and 2A to the extent practicable and reasonable. Because these areas are adjacent to Site 7 and have some similar characteristics and removal actions, this addendum to the *Site 7 EE/CA* is intended to expand the removal actions of Site 7 to include the removal actions for Site 4. This addendum to the *Site 7 EE/CA* identifies and evaluates two alternatives and then recommends one of the alternatives for effectively reducing the risk to the environment.

A removal action for Site 4 AOPCs 1A and 2A was deemed necessary because lead concentrations in soil are an ecological concern. DTSC stated that, although human health risk did not appear to be an issue, it is concerned about a few sample locations where higher lead concentrations were found (BNI, 2001b).

DTSC stated that they were unable to concur with the RSE's recommendations of NFA for soil at Site 4 AOPCs 1A and 2A because of ecological concerns. DTSC stated that the human health risk did not appear to be an issue, particularly due to the low exposure related to intermittent travel on Perimeter Road. DTSC did not comment on the specifics of the ecological risk assessment, except to say that they did not disagree with the ecological risk assessment results (BNI, 2001b).

A general discussion reviewed the RSE's analytical data and calculations on the exposure point concentrations (EPCs). DTSC did not disagree with the EPC calculation or use of the EPCs in the human health or ecological risk assessments. However, they were concerned about how to adequately address the few sample locations where higher lead concentrations were reported. DTSC suggested that additional sampling be performed at Site 4 AOPCs 1A and 2A in the vicinity of the previous locations where elevated lead concentrations were reported. These locations occur on the east end of AOPC 1A (sample locations SB4-01A-01, -03, -05, -15, and -18) where lead concentrations range from 1,390 to 7,760 mg/kg, and on the west and east ends of AOPC 2A (sample locations SB4-02A-04, -06, -15, and -17) where lead concentrations range from 1,370 to 3,500 mg/kg.

F3.2 Determination of Removal Schedule

Once the draft EE/CA Addendum is completed and approved by DON it would be available for public review and comment for 30 days. NAVWPNSTA Seal Beach would review the comments and direct the incorporation of public comments into the final EE/CA Addendum. The schedule for this removal action would be based on timely regulatory approval of the EE/CA Addendum, public acceptance of the Site 4 removal action, and adequate funding and contracting availability. Table F3-1 shows the projected schedule, assuming timely approval and selection of the preferred alternative.

The removal action to address the elevated lead detections found in Site 4 AOPCs 1A and 2A will be timed to coincide with the implementation of the removal action at the adjacent Site 7. Scheduling constraints associated with the Site 7 removal action are described in Section 3.3 of the 23 May 2002 Final *Site 7 EE/CA* (SWDIV, 2002). As discussed, this removal action will coincide with the Site 7 removal action.

The removal action and site restoration activities are expected to be completed in 2003. The schedule for Site 4 removal action activities for AOPCs 1A and 2A is presented in Table F3-1.

TABLE F3-1
Projected Removal Action Schedule for Site 4 NAVWPNSTA Seal Beach
Site 4 AOPCs 1A and 2A (Oil on Roads) EE/CA

Activity	Start Date	Completion Date
Complete Draft EE/CA	April 2003	June 2003
Applicable or Relevant and Appropriate Requirements (ARAR) Analysis and Concurrence	January 2003	March 2003
EE/CA Public Comment Period (RAB review)	June 2003	July 2003
Prepare Final EE/CA and Response to Public Comments (RAB comments)	July 2003	August 2003
Prepare Draft AM/RAP, California Environmental Quality Act (CEQA) Documentation, Fact Sheet, and Public Notice	July 2003	August 2003
RAB/Public Meeting	September 2003	September 2003
Prepare Final AM/RAP, CEQA Documentation, Fact Sheet, and Public Notice	September 2003	October 2003
Removal Action Planning and Review	October 2003	October 2003
Implement Site 4 Removal Action	November 2003	December 2003

To expedite the schedule the following activities will occur:

- A 30-day regulatory agency and RAB review will be requested.
- Preparation of the draft Action Memorandum/Remedial Action Plan (AM/RAP), CEQA documentation, Fact Sheet, and Public Notice will be prepared, submitted, and reviewed concurrently. These documents will include both Site 4 AOPCs A1 and A2 and Site 7 removal actions.

F3.3 Applicable or Relevant and Appropriate Requirements

The evaluation of applicable or relevant and appropriate requirements (ARARs) for Site 4 AOPCs 1A and 2A can be found in Attachment A. The following sections provide an overview of the ARARs process and a summary of those ARARs that potentially affect the development of removal action objectives (RAOs).

F3.3.1 ARARs Overview

As the lead federal agency, DON has the primary responsibility for the identification of federal ARARs at Site 4 AOPCs 1A and 2A. As the lead state agency, DTSC has the responsibility for identifying state ARARs (Attachment A). Requirements of ARARs and TBCs are generally divided into three categories: chemical-specific, location-specific, and action-specific. Chemical-specific and location-specific ARARs affecting the development of RAOs are discussed in the following section. Other chemical-specific, location-specific, and action-specific ARARs are presented in Section 4 for each of the alternatives considered. An evaluation of the ARARs considered for this EE/CA Addendum can be found in Attachment A.

DON has evaluated and concluded that no ARARs were identified for Site 4 AOPCs 1A and 2A beyond those ARARs already identified in the *Site 7 EE/CA* (SWDIV, 2002). The development and evaluation of the Site 7 ARARs are described in Section 3.4 of the 23 May 2002 *Site 7 EE/CA* (SWDIV, 2002). DTSC reviewed the DON's ARAR evaluation and concurred with its conclusions; the concurrence letter can be found in Attachment A (DTSC, 2003a). ARARs previously were requested from the state for Site 7. Because the Site 4 removal action for AOPCs 1A and 2A is being conducted concurrently with the Site 7 removal action, these same ARARs will be used for Site 4 AOPCs 1A and 2A as appropriate.

F3.3.2 ARARs Affecting RAOs

The substantive provisions of the following requirements also have been identified as location- and chemical-specific ARARs that affect the development of RAOs for Site 4 AOPCs 1A and 2A.

- National Wildlife Refuge System Administration Act of 1996, 16 U.S.C. § 668dd-668ee and 50 CFR § 27.11-27.97
- Protection of Wetlands, EO 11990
- Floodplain Management, EO 11988
- Endangered Species Act of 1973
- Migratory Bird Treaty Act
- California Fish and Game Code §§ 2080, 2014, 3005, and 5650(a), (b), and (f)
- State Water Resource Control Board Resolutions 68-16, 88-63, and 89-42
- California Code of Regulations, Title 27, §§ 20210, 20220, 20230, 20390, 20395, 20400, 20410, 20950, 22207(a), 22212(a), 22222
- California Water Code, Division 7, §§ 13241, 13243, 13263(a), 13269, and 13360
- Comprehensive Water Quality Control Plan for the Santa Ana Region Basin Plan (California Water Code § 13240), Chapters 4 and 5
- RCRA: California CFR Title 22 §§ 66261.21; 66261.22(a)(1); 66261.23; 66261.24(a)(1); 66261.100; 66261.24(a)(1)(B); 40 CFR § 261.24(a)

In general, these requirements prohibit the taking or harassing of wildlife from hazardous waste sites. These requirements are ARARs because the evaluation of ecological risk indicated that Site 4 AOPCs 1A and 2A posed a risk to wildlife (Section F2.5).

F3.4 Removal Action Objectives

Based on CERCLA, the NCP, the ARARs evaluation, and the human health and ecological risk assessments, the RAOs for Site 4 AOPCs 1A and 2A are as follows:

- Minimize further migration of lead in surface soil.
- Reduce risk to ecological receptors from lead-contaminated soil to acceptable levels.

To help achieve these RAOs, target cleanup goals (TCGs) were established for the areas where excavations would occur requiring confirmation sampling. Ecological risk-based TCGs were developed following the DTSC ecological risk assessment guidance (DTSC, 1996) and identifying the primary risks. For Site 4 AOPCs 1A and 2A, a site-specific maximum TCG of 600 mg/kg for lead coupled with an area-wide arithmetic average TCG of less than 100 mg/kg for lead were developed based on the risks to representative site-specific terrestrial receptors, which include ground squirrel, harvest mouse, skunk, and robin. The development of this site-specific TCG is described in Section F2.5.1.2.

Another primary risk identified at Site 4 AOPCs 1A and 2A involves the potential risks to aquatic ecological species due to the exposure of lead contamination during tidal water inundation that occurs at AOPCs 1A and 2A. These aquatic ecological risks are described in the RSE Report (BNI, 2001a).

Human exposure to Site 4 AOPCs 1A and 2A (especially the areas within the Seal Beach NWR) would be limited. Because wildlife refuges are established to protect wildlife, human presence is usually limited to brief visits by USFWS personnel and Navy security personnel. Additionally, there would not be any development on Site 4 AOPCs 1A and 2A due to its location next to a former landfill, proximity to the NWR, and its location within the explosive arc at NAVWPNSTA Seal Beach. Additionally, DTSC stated that the human health risk did not appear to be an issue, particularly due to the low exposure related to intermittent travel on Perimeter Road (BNI, 2001a).

F4. Identification and Analysis of Removal Action Alternatives

Based on the RAOs presented in the previous section, two alternatives have been developed for the removal action at Site 4 for AOPCs 1A and 2A. A brief summary of the alternatives evaluated in this EE/CA is:

- Alternative 1: No Action.
- Alternative 2: Excavation and Offsite Disposal. Primary removal action activities involve excavation and offsite disposal of lead contaminated soil for Site 4 AOPCs 1A and 2A.

F4.1 Evaluation Criteria

These alternatives were evaluated based on effectiveness, implementability, and cost. Brief descriptions of the evaluation criteria are provided below.

F4.1.1 Effectiveness

To evaluate effectiveness, consideration was given to the overall protection of public health and safety and the environment, and compliance with ARARs and other guidance. In addition, the removal action alternatives evaluation considered the following.

- Ability of the alternative to achieve RAOs
- Reduction of toxicity, mobility, or volume through treatment
- Long-term effectiveness and reliability in reducing long-term risks
- Short-term effectiveness

F4.1.2 Implementability

Evaluation of the implementability of each alternative included consideration of the technical feasibility, commercial availability, and administrative feasibility. Anticipated state and community acceptance also would be evaluated. The latter acceptance evaluation would be updated based on receipt of comments from the state and the community.

F4.1.3 Cost

The cost evaluation is based upon estimates for capital costs, annual operation and maintenance (O&M) costs, duration of removal action, and present worth. Capital costs would include the costs for design, materials, construction, equipment, mobilization, and decommissioning.

Annual O&M costs include monitoring, minor repair, and replacement costs. The present worth for each alternative is the sum of capital cost and O&M cost based on a 5-year present worth analysis. A present worth analysis is used to evaluate expenditures that occur over

different time periods by discounting all future costs to a common base year. The present worth was calculated using the following equation.

$$P = A \frac{(1 + i)^n - 1}{i(1 + i)^n}$$

where,

P = present worth
A = monthly costs (annual costs/12)
i = interest rate of 7 percent (annual percentage rate [APR]), compounded monthly
n = 60 months (5 years)

The present worth allows the cost of removal action alternatives to be compared on the basis of a single figure representing the amount of money that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the remedial action over its planned life. Inflation was not considered in this cost evaluation.

Brief descriptions of the removal action alternatives and the alternative evaluation discussions are presented in Subsections F4.2 to F4.4.

F4.2 Alternative 1—No Action

The following subsections provide a description and discussion of the effectiveness, implementability, and cost for Alternative 1.

F4.2.1 Description

Alternative 1 does not include additional characterization of the site or further action to remove waste materials or reduce risk posed by wastes at the site. A "no-action" alternative is required by the NCP to be evaluated in detail as an alternative. This removal action alternative was retained as a baseline against which other response actions could be compared and allows evaluation of the effect of responses that directly address the mitigation of impacted media. Under this alternative, the lead-contaminated soil at Site 4 AOPCs 1A and 2A is left in place.

The following subsections discuss the effectiveness, implementability, and cost for Alternative 1.

F4.2.2 Effectiveness

The No Action Alternative would not meet the RAOs stated in Section 3. Because no response actions would be implemented, long-term ecological risks for the site would be the same as the baseline risks described in the RSE for Site 4 (BNI, 2001a). At certain areas of Site 4 AOPCs 1A and 2A, contaminants would remain in the soil at concentrations exceeding ecological screening criteria for wildlife protection. Because the site currently poses a threat to ecological receptors, this alternative would not meet minimum standards established by the Endangered Species Act, the Migratory Bird Treaty Act, and California Department of Fish and Game (CDFG) Code 2080 and 3005, all of which prohibit the taking

or harassing of wildlife. Further, there would be no groundwater monitoring to determine whether potential contaminants detected in the groundwater could be migrating to aquatic receptors.

This alternative includes no controls to reduce the probability of exposure and no long-term management measures other than those that currently exist (i.e., because Site 4 lies within a naval facility, it benefits from the presence of military security and security fencing). All current and future risks would remain. This alternative would provide no reduction in toxicity, mobility, or volume through treatment.

F4.2.3 Implementability

There would be no implementability concerns posed by this alternative because no action would be taken. Since there would be no construction or implementation phase for this alternative, there would be no additional short-term risks posed to the community, workers, or the environment as a result of excavation of lead-contaminated soil. However, it is anticipated that the Alternative 1 would be unacceptable to the community and the state regulators.

F4.2.4 Costs

No costs would be incurred under the Alternative 1 for Site 4 AOPCs 1A and 2A.

F4.3 Alternative 2—Excavation of Contaminated Soil and Offsite Disposal with Monitoring

The following subsections provide a description and discussion of the effectiveness, implementability, and cost for Alternative 2.

F4.3.1 Description

Alternative 2 consists of excavation followed by offsite disposal and clean backfill.

It is estimated that approximately 600 cubic yards (cy) each of lead contaminated soil exists in Site 4 AOPCs 1A and 2A, respectively. The excavation volume, however, may vary significantly based on conditions encountered during x-ray fluorescence (XRF), excavation, and analytical sample confirmation. It is anticipated that in-place excavation volumes (excavated soils) in AOPC 1A could range from as low as 600 cy to as high as 2,200 cy. Similarly, in AOPC 2A, the in-place excavation volumes could range from as low as 600 cy to as high as 2,800 cy.

The excavation removal action at Site 4 AOPCs 1A and 2A comprises the following activities.

- Re-establish locations of elevated lead in soils
- Use XRF to identify lateral extent of lead-contaminated soil excavation
- Excavation of lead-contaminated soil within AOPCs 1A and 2A
- Confirmation sampling to verify successful attainment of RAOs
- Offsite disposal of excavated soil

- Backfill with clean fill
- Revegetating the clean fill

Because of the proximity of Site 4 AOPCs 1A and 2A to the Seal Beach NWR, all field activities would be coordinated with the USFWS refuge manager to minimize the potential for disturbing or harming nearby sensitive habitat.

F4.3.2 Effectiveness

Alternative 2 would meet the RAOs stated in Subsection 3.5 and would provide protection to public health and safety and the environment. Long-term risks to ecological receptors at Site 4 AOPCs 1A and 2A would be eliminated because the contaminated soils would be excavated and disposed offsite. Clean material would be used to backfill the excavation. Magnitude of residual risks would be minimal because the excavation alternative would remove lead-contaminated soil at concentrations higher than the target cleanup goal. No additional controls, such as access restrictions or land use restrictions, would be required.

Alternative 2 would meet ARARs by complying with guidelines of the Flood Plain Management (EO 11988), State Water Resource Control Board, California Code of Regulations, California Water Code, Comprehensive Water Quality Control Plan for the Santa Ana Region, and the Resource Conservation and Recovery Act, listed in Section 3.4.2. Removal of lead contaminated soil from Site 4 AOPCs 1A and 2A would reduce exposure to wildlife. It would meet requirements of the Endangered Species Act, the Migratory Bird Treaty Act, and CDFG Code 2080, 2014, and 3005, all of which prohibit the taking or harassing of wildlife. DON would coordinate with USFWS, U.S. Army Corps of Engineers (USACE), and CDFG during the removal action in this portion of the site to comply with the National Wildlife Refuge System Administration Act. This alternative would also be expected to meet the South Coast Air Quality Management District (SCAQMD) requirements because dust generated during implementation of the alternative would be controlled with dust-suppression technologies.

Alternative 2 would be highly reliable because the wastes would be excavated and then disposed offsite and, therefore, would not pose a risk in the future. Alternative 2 would not reduce toxicity, mobility, or volume of contaminants through treatment. Though excavation and offsite disposal would eliminate the source of contamination, there would be no reduction in toxicity, mobility, or volume through treatment.

With Alternative 2 there would be an added short-term risk (in terms of dust, noise, and traffic) associated with the excavation activities and truck transport of large volumes of waste material or imported fill material. There is also potential for short-term risk to the environment, community, and workers due to particulate emissions (and possibly vapor emissions from fossil-fueled vehicles) during excavation of wastes. Proper safety precautions, including dust control and precautionary vapor control technologies, would be necessary.

F4.3.3 Implementability

Alternative 2 is technically feasible. Extensive coordination requirements and health and safety measures would be required; however, no special techniques, equipment, materials, or labor would be required to excavate the wastes. The materials and procedures are

readily available and well established. Many contractors have the skill and experience to perform the earthwork, possible short-term dewatering, revegetation, and the needed excavation-related construction activities.

F4.3.4 Costs

The costs to implement Alternative 2 were estimated using vendor and contractor quotes and methodologies prescribed by EPA for Superfund sites. The cost range, in year 2003 dollars, is summarized below. A range of costs is provided because of the uncertainty involved in estimating the excavation volumes at Site 4 AOPCs 1A and 2A.

Estimated Capital Cost ($): 210,000 to 880,000
Estimated Annual O&M Cost ($): 0
Estimated Present Worth ($): **210,000 to 880,000**

A breakdown of the costs by major task and the cost ranges is shown in Table F4-1.

F4.4 Uncertainties

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Due to the difficulty in completely characterizing and quantifying the contamination at Site 4 AOPCs 1A and 2A, the scope of removal actions is based largely on assumptions. These estimates are based on representative cleanup actions comprised of example technologies. These estimates are presented for the purpose of making comparative evaluations and cost estimates, and are not necessarily the specific technologies or methods that would be a part of the final engineering work plan. The final cost of the project would depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final project schedule, the firm selected for final engineering design, and other variable factors. As a result, the final project cost would vary from the estimates presented herein.

A source of uncertainty that would affect the cost estimates presented in this EE/CA Addendum is the volume of material that would be excavated from Site 4 AOPCs 1A and 2A and the amount of dewatering that may be required during excavation.

As part of previous investigations at Site 4 AOPCs 1A and 2A, samples were collected and analyzed to better delineate the extent of contamination. Nevertheless, uncertainties lie with these volume estimates because previous investigations based findings on sampling points approximately 400 feet apart (BNI, 2001a). The actual soil volumes excavated from Site 4 AOPCs 1A and 2A may vary from the estimates presented in this EE/CA Addendum. The cost range provided is expected to capture this cost uncertainty.

In addition, the nature of the soil excavated (California-regulated nonhazardous waste versus California-regulated hazardous wastes versus RCRA hazardous wastes) also could impact the costs significantly. For the purposes of the cost estimates presented in this EE/CA, the nature of soil excavated from Site 4 AOPCs 1A and 2A is assumed to be 90 percent nonhazardous wastes (as defined by the California Code of Regulations Title 22) and 10 percent RCRA hazardous waste. The relatively lower percentage of hazardous waste

assumed is based on the levels of lead contamination detected in soil during previous investigations conducted at the site.

The amount of dewatering that may be required would depend on the actual depth to groundwater and soil moisture at the time of excavation. Both of these factors are dependent on time of excavation during the tidal cycle and on weather conditions.

Table F4-1. Summary of Estimated Removal Action Costs by Major Task

Site 4 EE/CA

NAVWPNSTA Seal Beach

Task	Units	Unit Costs	Alternative 1 - No Action	Alternative 2 - Excavation and Offsite Disposal	
			Cost	Low Cost	High Cost
Construction Direct Costs					
Mob/Demob/Operations	LS	-	$0	$6,173	$26,591
Survey	LS	-	$0	$1,500	$1,500
Site Preparation (access and clearing)	AC	$ 4,000	$0	$2,296	$10,537
X-Ray Fluorescence	WK	$ 1,500	$0	$1,300	$2,600
Excavation/Waste Handling in AOPC 1A	CY	$ 10	$0	$6,000	$22,000
Excavation/Waste Handling in AOPC 2A	CY	$ 10	$0	$6,000	$28,000
Relocation and Revegetation of Native Plant Species	AC	$ 20,000	$0	$11,478	$52,686
Excavation Confirmation Soil Sampling and Analysis for Lead	EA	$ 1,000	$0	$200	$900
Backfill Excavated Areas	CY	$ 18	$0	$21,600	$90,000
Sampling for Waste Characterization and Segregation	EA	$ 135	$0	$1,620	$6,750
Offsite Transportation and Disposal of Non-Haz Wastes	CY	$ 54	$0	$58,320	$243,000
Offsite Transportation and Disposal of Haz Wastes	CY	$ 122	$0	$14,640	$61,000
Monitoring Well Installation	LF	$ -	$0	$0	$0
Wetlands Mitigation Program	LS	$ 50,000	$0	$0	$14,348
Construction Subtotal			***$0***	***$132,000***	***$560,000***
Indirect Costs					
Field Office	LS		$0	$0	$0
Bid Contingency (15%)		15%	$0	$19,800	$84,000
Scope Contingency (20%)		20%	$0	$26,400	$112,000
Construction Total			***$0***	***$179,000***	***$756,000***
Permitting and Legal (3%)		3%	$0	$3,960	$16,800
Construction Quality Assurance (5%)		5%	$0	$6,600	$28,000
Services During Construction (8%)		8%	$0	$10,560	$44,800
Total Implementation Costs			***$0***	***$201,000***	***$846,000***
Engineering Design Costs (6%)		6%	$0	$7,920	$33,600
TOTAL CONSTRUCTION COSTS			**$0**	**$210,000**	**$880,000**
Annual O&M Costs - 5-year Duration					
Groundwater Monitoring	Ea	$ -	$0	$0	$0
Subtotal - 5-year Duration			***$0***	***$0***	***$0***
Contingency (10%)		10%	$0	$0	$0
Total Annual O&M			$0	$0	$0
O&M Present Worth for 5 yrs @ 2.8%APR (compounded monthly)	**3%**		**$0**	**$0**	**$0**
REMOVAL ACTION-ESTIMATED COST			**$0**	**$210,000**	**$880,000**

Assumptions:

Construction Costs

Excavation volumes based on areas presented in Bechtel Removal Site Evaluation (RSE) Report (Bechtel, 2001) and depth estimated to be 1 ft for practical purposes.

Assumes Site 4 removal action occurs concurrently with Site 7 removal action.

Costs associated with installation of new groundwater (GW) monitoring wells are accounted for separately under the Groundwater Monitoring Progarm at Installation Restoration Sites 4, 5, 6, and 7 (Bechtel, 2002)

Assumes dewatering is not anticipated since excavation will not exceed 12 inches. However, GW depths are shallow and if for some reason excavations are deeper than 12 inches, GW could be encountered. Therefore, there are uncertainties to whether dewatering will be required.

O&M Costs

Costs associated with O & M of GW monitoring wells are accounted for separately under the Groundwater Monitoring Progarm at Installation Restoration Sites 4, 5, 6, and 7 (Bechtel, 2002).

F5. Comparative Analysis of Removal Action Alternatives

In this section, the alternatives analyzed in Section F4 are compared against each order to evaluate the relative performance of each alternative in relation to each of the criterion. The criteria used in this comparison are the same as in Section F4, namely effectiveness, implementability, and cost. Table F5-1 presents a detailed summary of this comparison.

F5.1 Effectiveness of Alternatives

The effectiveness of each alternative was evaluated based on the overall protection of human health and the environment; long-term effectiveness and permanence; compliance with ARARs; reduction of toxicity, mobility, or volume through treatment; and short-term effectiveness.

F5.1.1 Overall Protection of Human Health and the Environment

Alternative 1, No Action, provides no protection for human health or the environment. Alternative 2 offers a higher degree of protectiveness for human health and the environment by removing the lead-contaminated soil from Site 4 AOPCs 1A and 2A, which poses a risk to ecological receptors.

F5.1.2 Long-Term Effectiveness and Permanence

Alternative 1 is not effective over the long-term because the lead in the soil could migrate towards or be consumed by ecological receptors.

The long-term effectiveness and permanence of Alternative 2 is higher than Alternative 1 because the soil remaining at Site 4 AOPCs 1A and 2A would not pose residual risk to ecological receptors.

F5.1.3 Compliance with ARARs

Alternative 1 does not meet minimum standards established by the Endangered Species Act, Migratory Bird Treaty Act, Protection of Wetlands (EO 11990), CDFG Code (2080, 2014, and 3005), Flood Plain Management (EO 11988), State Water Resource Control Board, California Code of Regulations, California Water Code, Comprehensive Water Quality Control Plan for the Santa Ana Region, the Resource Conservation and Recovery Act, and ARARs listed in Section F3.4.2. On the other hand, Alternative 2 removal actions may threaten wetlands and sensitive habitat, which may not meet minimum standards established by the Endangered Species Act, Migratory Bird Treaty Act, Protection of Wetlands (EO 11988), and CDFG ARARs. The excavation of lead-contaminated soils that is proposed in Alternative 2 activities would be carried out to a point where remaining lead concentrations are at or below regulatory agency-approved cleanup levels while protecting or restoring wetlands.

F5.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Neither of the alternatives evaluated would reduce toxicity, mobility, or volume of contaminants through treatment. However, Alternative 2 would involve excavation and removal of the lead-contaminated soils from the NWR portions of Site 4 AOPCs 1A and 2A for disposal at an approved facility (when treatment may or may not occur).

F5.1.5 Short-Term Effectiveness

The short-term effectiveness is lowest for Alternative 1 because the RAOs would never be met. Alternative 1 would not involve any removal action; therefore, any risk associated with the lead-contaminated soil would still exist.

The short-term effectiveness is higher for Alternative 2 because it would require excavation of lead-contaminated soil and transportation to an approved facility for disposal. Alternative 2 may require a substantial volume of soil backfill, so there is the added risk associated with the truck transport of imported fill material from an offsite source to the site. For Alternative 2, proper safety precautions, including dust control technologies, would be necessary. Alternative 2 would be more effective because there would be no unmanageable risks to the community, workers, or the environment during construction. Alternative 1 is not evaluated because there is no construction or implementation phase.

F5.2 Implementability of Alternatives

The implementability of Alternatives 1 and 2 was evaluated based on technical feasibility, commercial availability, administrative feasibility, anticipated regulatory acceptance, and anticipated community acceptance.

The alternatives use proven and demonstrated technologies and are feasible to implement. Alternative 2 involves earthwork and possible dewatering activities that can be provided by many local contractors. No special materials or labor are required for this alternative. However, the western portion of Site 4 AOPC 1A that is part of the NWR, is sensitive to wildlife and portions of Site 4 AOPC 2A meet the definition of wetlands. Therefore, if it is determined that lead-contaminated soil extends into the wetlands, mitigation measures for disturbance or destruction of wetlands or sensitive habitat would be required.

Technical feasibility, commercial availability, administrative feasibility, and community acceptance is not applicable to Alternative 1 because no action is taken. Although Alternative 2 would require standard contracting procedures, extensive approval and coordination requirement may be involved if contaminated soils extend into the wetlands. Regulatory and community acceptance should be more favorable than Alternative 1 because lead-contaminated soils would be removed for the site and only temporary disturbance would be anticipated.

TABLE F5-1. Comparative Analysis of Removal Action Alternatives
NAVWPNSTA Seal Beach
Site 4 AOPCs 1A and 2A EE/CA

Evaluation Criteria	Alternative 1: No Action	Alternative 2: Excavation and Offsite Disposal
Effectiveness		
• **Overall Protection of Human Health and the Environment**	Alternative 1 would not meet Removal Action Objectives (RAOs), and it provides the least overall protection of the environment compared to the alternatives considered. Immediate exposure as well as indirect exposure through stormwater runoff and/or wind erosion does not provide overall protection of human health and the environment.	Alternative 2 would meet RAOs. Risks are reduced through excavation of lead contaminated soil and offsite disposal at an approved facility. This alternative affords the maximum long-term protection to the environment. However, short-term risks during implementation are potentially high. Alternative 2 affords the greatest protection of the environment because Site 4 AOPCs 1A and 2A soils with lead concentrations exceeding the target cleanup goal (TCG) would be excavated and disposed offsite. Clean fill materials would be used to backfill the excavations.
• **Compliance with applicable or relevant and appropriate requirements (ARARs)**	Alternative 1 would not comply with ARARs.	Alternative 2 would comply with ARARs to the extent that protection of human health and the environment would be provided. • Lead contaminated soil and residuals would be removed to a point where remaining lead concentrations are at or below the TCG. • Extensive provisions to protect or improve existing water quality conditions are not required because of the existing hydrological conditions.

TABLE F5-1. Comparative Analysis of Removal Action Alternatives
NAVWPNSTA Seal Beach
Site 4 AOPCs 1A and 2A EE/CA

Evaluation Criteria	Alternative 1: No Action	Alternative 2: Excavation and Offsite Disposal
Long-Term Effectiveness and Permanence		
• **Magnitude of Residual Risk**	Under No Action, the magnitude of residual risk would be relatively high because the site would remain unchanged.	Under Alternative 2, the magnitude of residual risk would be relatively low because lead contaminated soil is excavated and disposed offsite at an approved facility.
• Adequacy and Reliability of Controls	Alternative 1 would not provide adequate and reliable controls since no removal action is taken.	Alternative 2 would not require any controls because lead contaminated soil at Site 4 AOPCs 1A and 2A is excavated and disposed offsite at an approved facility.
Reduction of Toxicity, Mobility, and Volume Through Treatment		
• Treatment Processes Used and Materials Treated • Amount of Hazardous Materials Destroyed or Treated • Expected Reductions in Toxicity, Mobility, and Volume • Irreversibility of Treatment • Type and Quantity of Treatment Residual	Alternative 1 would not reduce toxicity, mobility, or volume of contaminants through treatment.	Alternative 2 does not propose removal actions that involve treatment; therefore, Alternative 2 would not reduce toxicity, mobility, or volume of contaminants through treatment.

TABLE F5-1. Comparative Analysis of Removal Action Alternatives
NAVWPNSTA Seal Beach
Site 4 AOPCs 1A and 2A EE/CA

Evaluation Criteria	Alternative 1: No Action	Alternative 2: Excavation and Offsite Disposal
Short-Term Effectiveness		
• Protection of Community During Remedial Action • Protection of Workers During Removal Action • Environmental Impacts	Under No Action, unlike Alternative 2, there would not be any temporary risks posed to the community, workers, and the environment. However, risks from possible ongoing water seep discharges to the groundwater would exist.	Under Alternative 2, excavation of Site 4 AOPCs 1A and 2A would temporarily pose short-term risks to the workers and the environment (ecological receptors at the site). In general, there would be minor additional disturbance to the community during construction primarily due to increased traffic.
• Time Until RAOs are Achieved	Alternative 1 would not achieve the RAOs; therefore, the time taken would be indefinite.	It would take approximately 1 month to complete the removal actions under Alternative 2. The RAOs would be achieved upon completion of the excavation and backfilling activities.
Implementability		
• Technical Feasibility • Availability of Services and Materials	Alternative 1 would not have any technical implementability concerns because no action is being taken.	Under Alternative 2, the excavation activity at Site 4 AOPCs 1A and 2A does not require specialized equipment for excavation. The depth, area, and volume of excavation are expected to be limited to relatively small "hot spots," and specialized excavation, waste handling, and dewatering, are not expected to be required. The required equipment and experienced contractors are widely available in Southern California.

TABLE F5-1. Comparative Analysis of Removal Action Alternatives
NAVWPNSTA Seal Beach
Site 4 AOPCs 1A and 2A EE/CA

Evaluation Criteria	Alternative 1: No Action	Alternative 2: Excavation and Offsite Disposal
• Administrative Feasibility	Alternative 1 would not require any additional administration because no action is being taken.	There would be extensive regulatory coordination issues for excavation and offsite disposal. Because the removal action involves excavation within the NWR and adjacent wetland areas, DON would need to coordinate with DTSC, RWQCB, SCAQMD, USFWS, ACOE, and CDFG during the removal action.
• State (or Other Support Agency) Acceptance	It is anticipated that Alternative 1 would not be acceptable to the regulatory agencies (i.e., DTSC, RWQCB, USFWS, ACOE, and CDFG).	It is anticipated that DTSC, RWQCB, USFWS, ACOE, and CDFG would accept Alternative 2. However, the construction disturbance and site restoration may cause concern. The excavation of lead contaminated soil at Site 4 AOPCs 1A and 2A provides adequate protection of human health and the environment; therefore, this alternative would likely be the favored alternative for regulators.
• Community Acceptance	It is anticipated Alternative 1 may not be acceptable to the community.	The community's issues and concerns for Alternative 2 would be addressed based on public comments on the EE/CA. However, it is anticipated that the community would likely consider this alternative favorably because it involves removal of lead contaminated soil at Site 4 AOPCs 1A and 2A. One issue may be the increase in off-Station traffic, noise, and dust because of the need to transport and dispose waste materials offsite. Use of railroad transport for offsite waste hauling and onsite backfill would be a mitigating measure which would make traffic and noises issues less significant.

TABLE F5-1. Comparative Analysis of Removal Action Alternatives
NAVWPNSTA Seal Beach
Site 4 AOPCs 1A and 2A EE/CA

Evaluation Criteria	Alternative 1: No Action	Alternative 2: Excavation and Offsite Disposal
Cost		
Estimated Capital Costs ($ range)	$0	$210,000 to $880,000
Estimated Annual Operation and Maintenance (O&M) Costs	$0	$0
Estimated Present Worth ($ range)	$0	$210,000 to $880,000

Notes:

ACOE	United States Army Corps of Engineers
ARARs	applicable or relevant and appropriate requirements
CDFG	California Department of Fish and Game
DON	Department of the Navy
DTSC	Department of Toxic Substances Control
EE/CA	Engineering Evaluation/Cost Analysis
NWR	National Wildlife Refuge
O&M	Operation and Maintenance
RAOs	Removal Action Objectives
RWQCB	Regional Water Quality Control Board
SCAQMD	South Coast Air Quality Management District
TCGs	target cleanup goals
USFWS	United States Fish and Wildlife Service

F5.3 Cost of Alternatives

The capital, O&M, and total present worth costs for the alternatives are shown in Table F5-1. A breakdown of costs by major task also is presented in Table F5-1. Alternative 1, No Action, has the lowest net present worth cost, as expected, because no activities would take place. Alternative 2 is the higher cost alternative, having a net present worth cost between $210,000 and $880,000, which includes the costs of disposal of excavated material and replacement backfill.

F5.3.1 Sensitivity of Costs

The cost estimates were prepared assuming the following:

- Unit costs in 2003 dollars
- Local sources for soil import
- Transportation of lead-contaminated soil to an approved facility via rail haul
- No significant dewatering required
- Removal action for Site 4 AOPC 1A and 2A is implemented concurrently with Site 7 removal action

F6. Recommended Removal Action Alternative

The EE/CA was performed in accordance with current EPA and DON guidance documents for a non-time critical removal action under CERCLA. The purpose of this EE/CA is to identify and analyze alternative removal actions to address lead-contaminated soil at Site 4 AOPCs 1A and 2A at NAVWPNSTA Seal Beach. Two alternatives were identified, evaluated, and compared.

- Alternative 1—No Action
- Alternative 2—Excavation and Offsite Disposal

This Site 4 removal action for AOPCs 1A and 2A will be conducted concurrently with the Site 7 removal action because the lead-contaminated soil hot spots are adjacent to Site 7 Station Landfill.

Based on the comparative analyses of the removal action alternatives completed in Section 5, the recommended removal action is Alternative 2. Alternative 2 consists of excavation followed by offsite disposal and clean imported backfill. The details for implementing the recommended alternative would be developed by the RAC and would be discussed in the RAP.

Excavation and offsite disposal of wastes is proposed to mitigate possible long-term risks to ecological receptors. Using field instrument technology (e.g., XRF) in conjunction with quality-controlled offsite commercial laboratory analyses, the lateral extent of lead contamination would be further delimited beyond that identified by the Site 4 AOPCs 1A and 2A RSE (BNI, 2001a). The removal action would involve excavation of lead contaminated soil. The excavated material would then be hauled offsite and disposed in an approved landfill. Clean earthfill would be used to backfill the excavation. The remediated areas would be revegetated to be consistent with the surrounding habitat.

Alternative 2, Excavation and Offsite Disposal is the recommended removal action because this alternative:

- Adequately protects public health and safety and the environment
- Complies with ARARs
- Meets the RAOs
- Provides moderate long-term effectiveness
- Provides high short-term effectiveness because of low impacts on the community, workers, and the environment
- Provides high technical feasibility and low administrative requirements
- Provides high reasonableness of costs, offering the highest benefit in terms of achieving RAOs for the estimated cost

F7. References

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Attachment A
Applicable or Relevant and Appropriate Requirements Evaluation and DTSC Concurrence Letter for ARARs

DEPARTMENT OF THE NAVY
SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
1220 PACIFIC HIGHWAY
SAN DIEGO, CA 92132-5190

5090
Ser 5NEN.SL/057
3 FEB 03

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Katherine Leibel
Office of Military Facilities
Department of Toxic Substances Control
Region 4
5796 Corporate Avenue
Cypress, CA 90630

Dear Ms. Leibel:

Pursuant to the Naval Weapons Station, Seal Beach IRP Project Managers Meeting held on 18 Sep 02, the Navy reviewed the ARARs identified in the final Engineering Evaluation/Cost Analysis (EE/CA) Report for Site 7 Station Landfill (SWDIV, 2002) for pertinence to Site 4 AOPCs 1A and 2A. The review of Site 7 ARARs was performed to identify if additional ARARs for Site 4 AOPCs 1A and 2A are needed. This review was necessary because of the Navy's decision to add Site 4 AOPCs 1A and 2A to the removal action for Site 7. Chemical-, location-, and action-specific ARARs were included in the review. No additional ARARs were identified for the inclusion of Site 4 AOPCs 1A and 2A to the Site 7 removal action.

Analytical data for AOPCs 1A and 2A, presented in the final Removal Site Evaluation Report (SWDIV, 2001) for Site 4, were reviewed. In soil samples from AOPC 1A, total 2,3,7,8-TCDD values exceeded the residential Preliminary Remediation Goal (rPRG) in 14 of 44 samples. Also, lead values were reported above statistical background. In groundwater samples from AOPC 1A, antimony and hexavalent chromium levels were above statistical background; the hazard quotient (HQ) values were 7.0 and 4.8 respectively, for the ecological risk assessment (ERA).

In soil samples from AOPC 2A, lead levels were above statistical background; the low-HQ value was exceeded for the robin (HQ=230). Total 2,3,7,8-TCDD values exceeded the rPRG in 16 of 34 samples; the HQ values were slightly exceeded for several indicator species. Also, lead values were reported at elevated concentrations indicating potential adverse health effects for a residential scenario at AOPC 2A. In groundwater samples from AOPC 2A, arsenic, antimony, and hexavalent chromium levels were above statistical background; the HQ values were 4.5, 5.3, and 1.2, respectively for the ERA.

Although Site 4 AOPCs 1A and 2A may have different chemicals of potential concern (COPCs) or different concentrations of COPCs compared to Site 7, no additional chemical-specific ARARs were identified.

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An Archaeological Resource Protection Plan (ARPP) for Site 4 (Chambers Group, 1994) was reviewed to identify any additional cultural or historical ARARs. The ARPP did not identify any cultural resources in the vicinity of AOPCs 1A and 2A (although a marine shell deposit was identified along the Westminster Avenue portion of Site 4 approximately two miles north of AOPCs 1A and 2A). Therefore, no cultural ARARs were identified for Site 4. No other additional location-specific ARARs were identified for Site 4 since AOPCs 1A and 2A are located directly south and adjacent to Site 7.

The planned removal action for Site 4 AOPCs 1A and 2A is excavation and off-site disposal. These activities are addressed in the removal action planned for Site 7. Therefore, no additional action-specific ARARs were identified for Site 4 AOPCs 1A and 2A.

In conclusion, no ARARs were identified for Site 4 AOPCs 1A and 2A in addition to the ARARs already identified in the final EE/CA for Site 7. Your concurrence or comments for this evaluation and our inclusion of Site 4 removal action with current planned Site 7 removal action is requested by 12 Feb 03. If you have any questions, please contact Si Le, at (619) 532-1235.

Sincerely,

M. R. GOOD
By direction of the Commander

Copy to:
Commanding Officer (Code N45WW)
Attn: Pei-Fen Tomashiro
Naval Weapons Station, Seal Beach, Bldg 110
800 Seal Beach Boulevard
Seal Beach, CA 90740-5000

Bryant Wong
CH2M Hill
3 Hutton Centre Drive, Suite 200
Santa Ana, CA 92707

Department of Toxic Substances Control

Edwin F. Lowry, Director
5796 Corporate Avenue
Cypress, California 90630

Winston H. Hickox
Agency Secretary
California Environmental
Protection Agency

Gray Davis
Governor

February 27, 2003

Mr. Mark Good
Department of the Navy
Naval Facilities Engineering Command
1220 Pacific Highway
San Diego, California 92132-5190

Dear Mr. Good:

This is in response to your letter dated February 3, 2003. The letter indicated that the Navy has reviewed the ARARs identified in the final Engineering Evaluation/Cost Analysis (EE/CA) Report for Site 7 Station Landfill for pertinence to Site 4 AOPCs 1A and 2A. The review of Site 7 ARARs was performed to identify if additional ARARs for Site 4 AOPCs 1A and 2A are needed. The review was necessary because of the Navy's decision to add Site 4 AOPCs 1A and 2 A to the Site 7 removal action.

The Department of Toxic Substances Control hereby concurs with the Navy that no ARARs were identified for Site 4 AOPCs 1A and 2A in addition to the ARARs already identified in the final EE/CA for Site 7.

If you have any questions, please contact Ms. Katherine Leibel, Remedial Project Manager at (714) 484-5446.

Sincerely,

Shelia Lowe

Shelia Lowe
Unit Chief
Federal Facilities Unit B
Southern California Region
Office of Military Facilities

cc: Mr. Si Le
Remedial Project Manager
SWDIV Naval Facilities Engineering Command
1220 Pacific Coast Highway
San Diego, California 92132-5190

Ms. Pei-Fen Tamashiro
Naval Weapons Station, Seal Beach, Bldg110
800 Seal Beach Boulevard
Seal Beach, CA 90740-5000

Attachment B
Summary of Data for Site 4 AOPCs 1A and 2A

Attachment B-1
Site 7 – Summary of Detected Analytes, Soil Samples (SWDIV, 1990b)

Table 4.6-4
Site 7 - Summary of Detected Analytes
Soil Samples

Volatile Organic Compounds (EPA Method 8240)	BLANK Soil ug/kg	W41-7-1 Soil ug/kg	W41-7-5 Soil ug/kg	W41-7-5D Soil ug/kg	W41-7-10 Soil ug/kg	W42-7-1 Soil ug/kg	W42-7-5 Soil ug/kg	W42-7-10 Soil ug/kg	W43-7-1 Soil ug/kg	W43-7-5 Soil ug/kg	W43-7-10 Soil ug/kg	W43-7-10D Soil ug/kg
Methylene chloride	8	600 b	580 b	400 b	510 b	380 b	350 b	310 b				
Toluene									190		9.3	34
Metallic Compounds	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Silver (Ag), total												5.6
Arsenic (As), total	2.6	4.4	2.9	3.6	15.5	1.9	1.5	NR	NR	NR	NR	
Cadmium (Cd), total					0.7			NR	NR	NR	NR	
Chromium (Cr), total	17.5	32.3	28.9	24.6	86.6	11.8	13.6	24.3	26	53.4		37.2
Copper (Cu), total	26	35.9	64.2	26.7	68.8	9.6	15.2	NR	NR	NR	NR	
Mercury (Hg), total	0.15		0.15		0.91			0.5	0.67	0.58	0.58	
Nickel (Ni), total	12	21	21	12	21	7	11	19.1	19.8	27.4	16.8	
Lead (Pb), total	28	21	19	14	2080	10	9	5.7	2.8	6.6	5.2	
Zinc (Zn), total	126	94	92	65	437	43	72	85.4	66.6	112	88.8	
Semi-Volatile Organic Compounds (EPA Method 8270)	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	
Chrysene								160				
Di-n-butyl phthalate								170				
Fluoranthene								120				
4-chloro-3-methylphenol												

Note:
Blank indicates analyte not detected.
NR indicates analysis not requested.
b indicates present in blank.
D indicates duplicate.

Attachment B-2
Surface Soil Screening Locations and Results (SWDIV, 1995a)

Table 4-14
Surface Soil Field Screening Results - Site 7
NWS Seal Beach
RI Report

Station No.	Sample No.	Chromium (mg/kg)	Exceeds Criteria	Lead (mg/kg)	Exceeds Criteria	Zinc (mg/kg)	Exceeds Criteria
Lead "Hot Spot"							
07G09	07G09SA0-1	33.		539.	X	194.	
07G10	07G10SA0-1	60.	X	1,120.	X	366.	
07G11	07G11SA0-1	65.	X	1,540.	X	386.	
07G12	07G12SA0-1	30.		539.	X	194.	
07G13	07G13SA0-1	126.	X	509.	X	297.	
07G14	07G14SA0-1	75.	X	1,110.	X	373.	
07G15	07G15SA0-1	200.	X	4,940.	X	706.	X
07G16	07G16SA0-1	198.	X	4,490.	X	655.	X
07G17	07G17SA0-1	22.		83.		86.	
07G18	07G18SA0-1	18.		22.		70.	
07G19	07G19SA0-1	85.	X	5,180.	X	645.	X
07G20	07G20SA0-1	16.		36.		71.	
07G21	07G21SA0-1	15.		15.		74.	
07G22	07G22SA0-1	37.		1,590.	X	508.	
07G23	07G23SA0-1	21.		191.	X	126.	
07G23	07G23SA1-1	22.		166.	X	119.	
07G24	07G24SA0-1	19.		306.	X	139.	
07G25	07G25SA0-1	28.		96.		106.	
07G26	07G26SA0-1	78.	X	629.	X	112.	
07G27	07G27SA0-1	18.		107.		84.	
07G28	07G28SA0-1	16.		150.	X	76.	
07G29	07G29SA0-1	69.	X	945.	X	302.	
07G30	07G30SA0-1	80.	X	3,020.	X	400.	
07G31	07G31SA0-1	52.	X	268.	X	206.	
07G32	07G32SA0-1	46.	X	444.	X	204.	
07G33	07G33SA0-1	56.	X	363.	X	1,330.	X
07G34	07G34SA0-1	45.	X	465.	X	180.	
07G35	07G35SA0-1	34.		556.	X	193.	

Notes:
X = Exceeds screening criteria (44 mg/kg for chromium, 146 mg/kg for lead or 627 mg/kg for zinc).

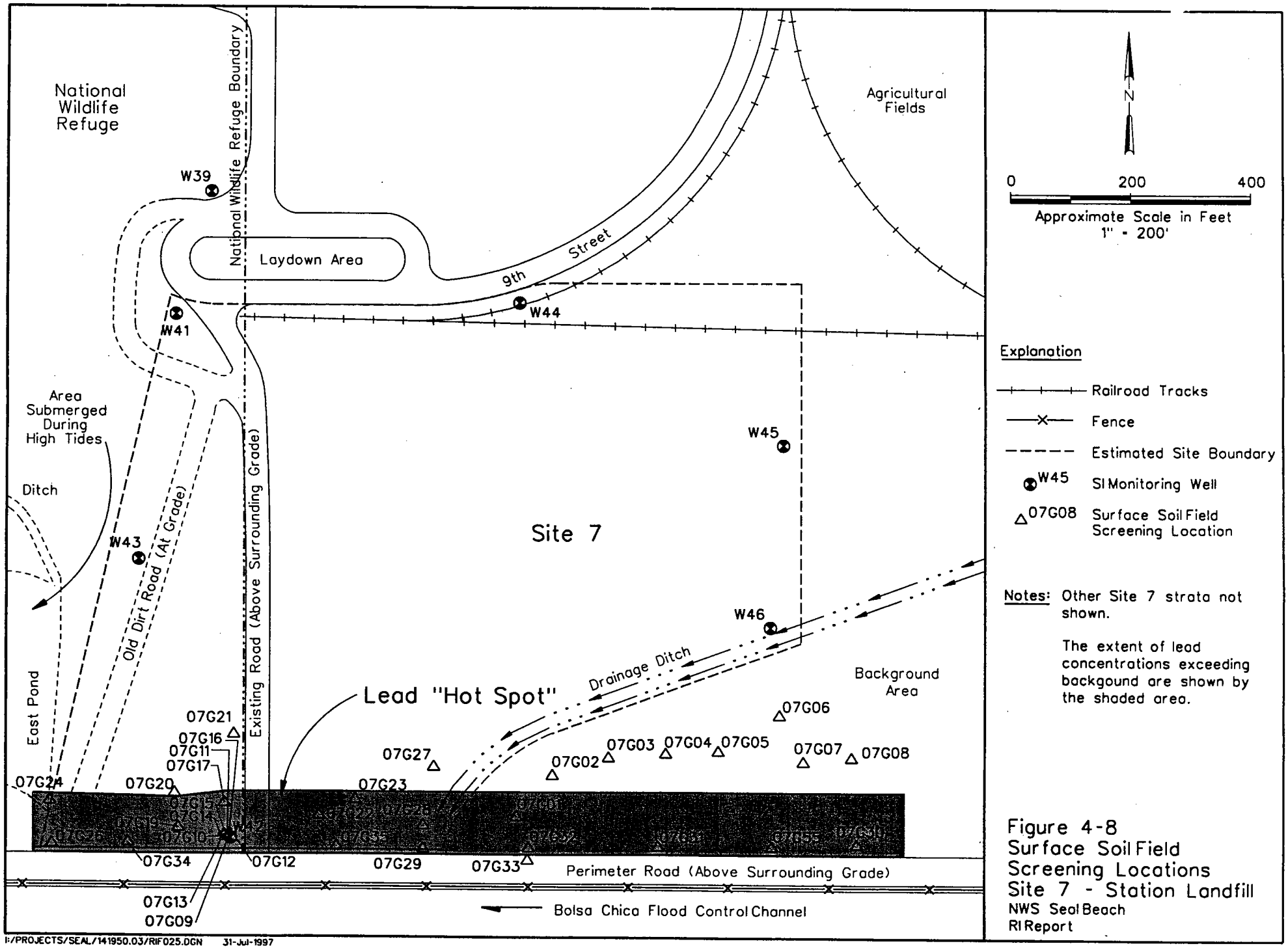


Figure 4-8
Surface Soil Field Screening Locations
Site 7 - Station Landfill
NWS Seal Beach
RI Report

I:/PROJECTS/SEAL/141950.03/RIF025.DGN 31-Jul-1997

Attachment B-3
Analytical Results of Detected Analytes in Soil Samples Collected from IRP Site 4 AOPCs 1A and 2A (BNI, 2001a)

Table 5-5
Analytical Results of Detected Analytes in Soil Samples Collected from IRP Site 4 AOPC 1A

Analyte	Station ID	SB4-01A-01		SB4-01A-02		SB4-01A-03		SB4-01A-04	
	Sample Depth, feet bgs	0 - 1	2 - 2.5	0 - 1	2 - 2.5	0 - 1	2 - 2.5	0 - 1	2 - 2.5
pH		8.02	7.54	8.35	8.29	8.24	8.09	8.11	7.91
TOTAL ORGANIC CARBON, %		1.05J	0.56	0.38	0.49	2.41	0.39	0.53J	
PAHs, mg/kg									
ACENAPHTHYLENE		10U	0.1U	0.1U	0.1U	10U	0.1U	10U	0.1U
ANTHRACENE		1U	0.01U	0.01U	0.01U	1U	0.01U	1U	0.01U
BENZ(A)ANTHRACENE		1U	0.01U	0.01U	0.01U	1U	0.01U	1U	0.01U
BENZO(A)PYRENE		1U	0.01U	0.003J	0.004J	0.6J	0.01U	1U	0.01U
BENZO(B)FLUORANTHENE		2U	0.006J	0.005J	0.02U	1J	0.009J	2U	0.02U
BENZO(G,H,I)PERYLENE		2U	0.02U	0.02U	0.02U	2U	0.02U	2U	0.02U
BENZO(K)FLUORANTHENE		1U	0.01U	0.01U	0.01U	1U	0.01U	1U	0.01U
CHRYSENE		1U	0.01U	0.01U	0.01U	1U	0.01U	1U	0.01U
DIBENZ(A,H)ANTHRACENE		1U	0.01U	0.01U	0.01U	1U	0.01U	1U	0.01U
FLUORANTHENE		2U	0.02U	0.02U	0.02U	2U	0.02U	2U	0.02U
FLUORENE		2U	0.02U	0.02U	0.02U	2U	0.02U	2U	0.02U
INDENO(1,2,3-CD)PYRENE		1U	0.01U	0.01U	0.01U	1U	0.01U	1U	0.01U
NAPHTHALENE		10U	0.1U	0.1U	0.1U	10U	0.1U	10U	0.1U
PHENANTHRENE		1U	0.01U	0.01U	0.01U	1U	0.01U	1U	0.01U
PYRENE		2U	0.02U	0.02U	0.02U	2U	0.02U	2U	0.02U
PCDDs/PCDFs, pg/g									
1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN		304J	8.3J	7.8J	0.5U	173	3J	67	1U
1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN		24600J	720J	492J	39.3J	13960J	219J	5120J	55.1
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN		200	6.1	6.1	0.59J	115	2.5J	53.4	2.7U
1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN		2920J	77.4	67	4.7J	1640	28.5	798	7.9
1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN		20.7J	0.5UJ	0.3U	0.3U	11	0.2U	4.4J	0.5U
1,2,3,4,7,8-HEXACHLORODIBENZOFURAN		31.9	1J	0.73J	0.2U	23.2	0.38J	6.9	1.2U
1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN		28	0.67J	0.86J	0.2U	12.1	0.32J	4.3J	0.4U
1,2,3,6,7,8-HEXACHLORODIBENZOFURAN		28.7	0.95J	0.65J	0.1U	21.5	0.43J	4.7J	0.64U
1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN		97	2.4J	2.4J	0.2U	45.6	0.8J	15.7	0.4U
1,2,3,7,8,9-HEXACHLORODIBENZOFURAN		1.1J	0.2U	0.2U	0.2U	0.32J	0.1U	0.2U	0.3U
1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN		107	2.6J	2.4J	0.2U	43	1J	17	0.4U
1,2,3,7,8-PENTACHLORODIBENZOFURAN		7.1J	0.35J	0.1U	0.1U	3.4J	0.09U	1.1J	0.58J
1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN		14.9J	0.52J	0.2U	0.1U	7.9	0.1U	1.4J	0.3U
2,3,4,6,7,8-HEXACHLORODIBENZOFURAN		66.4	2	1.5J	0.2U	51.3	0.94J	10.3	0.93U
2,3,4,7,8-PENTACHLORODIBENZOFURAN		29.1J	0.98J	0.66J	0.1U	18.1	0.42J	4J	0.95U
2,3,7,8-TETRACHLORODIBENZOFURAN		24.4	1.6	0.82J	0.1U	17.3	0.45J	2.6	1.5
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN		2	0.1U	0.4J	0.2U	1.1	0.1U	0.2U	0.3U
2,3,7,8-TCDD-EQUIVALENT, TOTAL		119J	3.45J	2.90J	0.092J	67.5J	1.17J	22.7J	0.31J
PCBs, mg/kg									
AROCLOR-1254		0.2	0.04J	0.1U	0.1U	0.4	0.1U	0.07J	0.1U
AROCLOR-1260		0.09J	0.1U	0.1U	0.1U	0.2	0.1U	0.03J	0.1U
METALS, mg/kg									
ALUMINUM		22000	19300	14900	15100	20600	17400	20600	26800
ANTIMONY		7.3J	6.3J	6.9J	5.4UJ	5.6UJ	5.6UJ		
ARSENIC		11	4.5	5.1	2.9	13.4	4.4	3.8	4.2
BARIUM		1290	130	102	108	771	107	189	181
BERYLLIUM		0.81	0.68	0.56	0.52	0.72	0.62	0.93	1.2
CADMIUM		0.61U	0.56U	0.53U	0.53U	0.72	0.54U	0.55U	0.64U
CHROMIUM		100J	27.9J	36.9J	21.4J	65.2J	24.5J	29.8J	37.7J
COBALT		13.6	10.7	8.3	8.5	11.2	10.5	11.8	15.3
COPPER		84.7	20.7	17.1	13.2	59.6	18.7	30.6	40.9
LEAD		3160J	161J	37.4J	9.4J	7760J	145J	148	82
MANGANESE		526	399	424	346	476	381	452	553
MERCURY		0.44	0.06U	0.05U	0.06U	0.3	0.06U	0.06UJ	0.07UJ
NICKEL		31.4	19.6	17.2	15.5	22.4	17.8	21.3	26.8
SELENIUM		0.55UJ	0.51UJ	0.48UJ	0.48J	0.49UJ	0.49UJ		
SILVER		0.72U	0.66U	0.8	0.62U	0.64U	0.64U	0.68	0.64
THALLIUM		0.36J	0.28J	0.24J	0.24	0.29J	0.25	0.25	0.29
VANADIUM		67.4	50.2	41.3	44.4	57.6	49.8	56.7	74.5
ZINC		778J	102J	64.4J	70.2J	630J	77J	143J	116J

(table continues)

Table 5-5
Analytical Results of Detected Analytes in Soil Samples Collected from IRP Site 4 AOPC 1A

Analyte	Station ID	SB4-01A-05		SB4-01A-06		SB4-01A-07		SB4-01A-08	
	Sample Depth, feet bgs	0 - 1	2 - 2.5	0 - 1	2 - 2.5	0 - 1	2 - 2.5	0 - 1	2 - 2.5
pH		8.11	8.53	8.06	8.14	8.09	8.23	8.19	7.99
TOTAL ORGANIC CARBON, %									
PAHs, mg/kg									
ACENAPHTHYLENE		10U	1U	10U	1U	10U	0.1U	0.1U	0.1U
ANTHRACENE		1U	0.1U	1U	0.1U	1U	0.01U	0.01U	0.01U
BENZ(A)ANTHRACENE		1U	0.1U	1U	0.1U	1U	0.01U	0.01U	0.01U
BENZO(A)PYRENE		1U	0.1U	1U	0.1U	1U	0.01U	0.01U	0.01U
BENZO(B)FLUORANTHENE		2U	0.2U	2U	0.2U	2U	0.02U	0.02U	0.02U
BENZO(G,H,I)PERYLENE		2U	0.2U	2U	0.2U	2U	0.02U	0.02U	0.02U
BENZO(K)FLUORANTHENE		1U	0.1U	1U	0.1U	1U	0.01U	0.01U	0.01U
CHRYSENE		1U	0.1U	1U	0.1U	1U	0.01U	0.01U	0.01U
DIBENZ(A,H)ANTHRACENE		1U	0.1U	1U	0.1U	1U	0.01U	0.01U	0.01U
FLUORANTHENE		2U	0.2U	2U	0.2U	2U	0.02U	0.02U	0.02U
FLUORENE		2U	0.2U	2U	0.2U	2U	0.02U	0.02U	0.02U
INDENO(1,2,3-CD)PYRENE		1U	0.1U	1U	0.1U	1U	0.01U	0.01U	0.01U
NAPHTHALENE		10U	1U	10U	1U	10U	0.1U	0.1U	0.1U
PHENANTHRENE		1U	0.1U	1U	0.1U	1U	0.01U	0.01U	0.01U
PYRENE		2U	0.2U	2U	0.2U	2U	0.02U	0.02U	0.02U
PCDDs/PCDFs, pg/g									
1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN		39.7J	8.2J	41.9	0.5U	30.6	0.9U	3.4J	2.3J
1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN		4670J	771	3820	41	2850	106	102J	5.8J
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN		36.1J	7.5	35.8	2U	23.6	2.4U	4.4U	2.6U
1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN		578J	74.3	360	4J	309	11.6	16.4	2.7J
1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN		2.9J	0.92U	3.1J	0.3U	2J	0.5U	0.38U	0.5U
1,2,3,4,7,8-HEXACHLORODIBENZOFURAN		9.6	2.7J	7.9	1.1U	5.5	1.4U	1.7U	2.1U
1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN		4.3J	0.8J	3.2J	0.2U	2.3J	0.4U	0.43J	0.4U
1,2,3,6,7,8-HEXACHLORODIBENZOFURAN		5	1.3J	4.9J	0.54U	3.4J	0.2U	0.9U	0.9U
1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN		14.4	2.9J	11.4	0.48J	8.4	0.4U	0.97J	0.4U
1,2,3,7,8,9-HEXACHLORODIBENZOFURAN		0.7U	0.2U	0.3U	0.1U	0.2U	0.3U	0.1U	0.3U
1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN		12.5	2.8J	9.1	0.2U	7	0.4U	1.1J	0.4U
1,2,3,7,8-PENTACHLORODIBENZOFURAN		1.7J	0.67J	1.4J	0.36J	1.3J	0.3U	0.65J	0.3U
1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN		2.5J	0.82J	1.5J	0.1U	1.3J	0.3U	0.37J	0.3U
2,3,4,6,7,8-HEXACHLORODIBENZOFURAN		10.7	2.8J	10.9	0.49U	8.2	0.2U	1.1U	0.68U
2,3,4,7,8-PENTACHLORODIBENZOFURAN		7.3	1.6J	4.1J	0.37U	4.4J	0.3U	1U	0.3U
2,3,7,8-TETRACHLORODIBENZOFURAN		7.2	2.3	3.3		4	0.92U	1.5	1.4
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN		0.3U	0.2U	0.3U	0.1U	0.2U	0.3U	0.1U	0.3U
2,3,7,8-TCDD-EQUIVALENT, TOTAL		22.2J	4.40J	15.8J	0.15J	13.0J	0.22	0.89J	0.18J
PCBs, mg/kg									
AROCLOR-1254		0.5	0.05J	0.1	0.1U	0.06J	0.1U	0.1U	0.1U
AROCLOR-1260		0.2	0.1U	0.1	0.1U	0.05J	0.1U	0.1U	0.1U
METALS, mg/kg									
ALUMINUM		14600	18400	10400	20300	19400	20800	12800	15100
ANTIMONY									
ARSENIC		7.1	3	2.5	2.9	5.3	3.2	2.1	7.3
BARIUM		957	110	156	152	149	121	80.5	85.7
BERYLLIUM		0.56	0.9	0.42	0.78	0.8	0.78	0.51	0.71
CADMIUM		0.53U	0.57U	0.53U	0.56U	0.53U	0.53U	0.55U	0.55U
CHROMIUM		134J	24.9J	21.8J	25.6J	30.6J	25.9J	17.7J	18.5J
COBALT		10.8	11.4	6.4	10.6	10.5	11.2	7.5	8.4
COPPER		52.6	24.1	17.7	21.4	28.2	23.3	15.6	19.8
LEAD		1860	66.5	296	20.8	554	11.7	13.1	9.6
MANGANESE		388	426	260	386	453	566	324	417
MERCURY		0.75J	0.06UJ	0.29J	0.06UJ	0.32J	0.05UJ	0.06UJ	0.06UJ
NICKEL		22	17.2	10.1	18.8	17.1	17.8	13.2	14
SELENIUM									
SILVER		0.55	0.58	0.43U	0.48	0.43	0.44U	0.45U	0.45U
THALLIUM		0.24U	0.26U	0.24U	0.25U	0.26	0.27	0.25U	0.28
VANADIUM		44.5	50.3	31.5	55.9	52.6	56.5	37.9	40.5
ZINC		432J	77J	177J	75.5J	119J	78.4J	62.9J	62.9J

(table continues)

Table 5-5
Analytical Results of Detected Analytes
in Soil Samples Collected from IRP Site 4
AOPC 1A

Analyte	Station ID	SB4-01A-09		SB4-01A-10		SB4-01A-11		SB4-01A-12	
	Sample Depth, feet bgs	0 - 1	2 - 2.5	0 - 1	2 - 2.5	0 - 1	2 - 2.5	0 - 1	2 - 2.5
pH									
TOTAL ORGANIC CARBON, %									
PAHs, mg/kg									
ACENAPHTHYLENE		0.04J	0.02J	0.03J	0.09J	1U	1U	0.1U	0.1U
ANTHRACENE		0.01U	0.01U	0.01U	0.01U	0.1U	0.1U	0.01U	0.01U
BENZ(A)ANTHRACENE		0.01U	0.01U	0.01U	0.01U	0.1U	0.1U	0.01U	0.01U
BENZO(A)PYRENE		0.01U	0.004J	0.01U	0.01U	0.1U	0.1U	0.01U	0.01U
BENZO(B)FLUORANTHENE		0.02U	0.008J	0.01J	0.02U	0.2U	0.2U	0.02U	0.02U
BENZO(G,H,I)PERYLENE		0.02U	0.006J	0.02U	0.02U	0.2U	0.2U	0.02U	0.02U
BENZO(K)FLUORANTHENE		0.01U	0.01U	0.01U	0.01U	0.1U	0.1U	0.01U	0.01U
CHRYSENE		0.01U	0.01U	0.01U	0.01U	0.1U	0.1U	0.01U	0.01U
DIBENZ(A,H)ANTHRACENE		0.01U	0.01U	0.01U	0.01U	0.1U	0.1U	0.01U	0.01U
FLUORANTHENE		0.02U	0.02U	0.02U	0.02U	0.2UJ	0.2UJ	0.02UJ	0.02UJ
FLUORENE		0.02U	0.02U	0.02U	0.02U	0.2U	0.2U	0.02U	0.02U
INDENO(1,2,3-CD)PYRENE		0.01U	0.01U	0.01U	0.01U	0.1U	0.1U	0.01U	0.01U
NAPHTHALENE		0.1U	0.1U	0.1U	0.1U	1U	1U	0.1U	0.1U
PHENANTHRENE		0.01U	0.01U	0.01U	0.01U	0.1U	0.1U	0.01U	0.01U
PYRENE		0.02U	0.02U	0.02U	0.02U	0.2U	0.2U	0.02U	0.02U
PCDDs/PCDFs, pg/g									
1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN		12.1J	0.6UJ	10.4J	0.2U	19.5	1.8U	6.1J	2.2J
1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN		421J	0.8UJ	307J	1.2J	337J	1.2UJ	145J	28.9J
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN		8.4	0.2UJ	4.8J	0.1U	8.9	0.7U	4.5J	1.3J
1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN		60.3J	0.3UJ	35.1J	0.2U	50.6J	1.1UJ	19.1J	5.3J
1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN		0.6J	0.3UJ	0.53J	0.1U	1.3UJ	1UJ	0.4UJ	0.4UJ
1,2,3,4,7,8-HEXACHLORODIBENZOFURAN		0.97J	0.1UJ	0.55J	0.08U	1.1J	0.5U	0.2U	0.2U
1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN		0.84J	0.2UJ	0.36J	0.1U	0.88J	0.6UJ	0.3UJ	0.3UJ
1,2,3,6,7,8-HEXACHLORODIBENZOFURAN		0.92J	0.1UJ	0.51J	0.07U	0.87J	0.4U	0.2U	0.2U
1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN		2.2J	0.2UJ	1.1J	0.1U	2.8J	0.6U	1.1J	0.2U
1,2,3,7,8,9-HEXACHLORODIBENZOFURAN		0.1U	0.2UJ	0.09U	0.09U	0.7UJ	0.6UJ	0.3UJ	0.2UJ
1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN		2.3J	0.2UJ	1.1J	0.1U	2.8J	0.7U	1.1J	0.3U
1,2,3,7,8-PENTACHLORODIBENZOFURAN		0.37J	0.1UJ	0.07U	0.08U	0.6U	0.5U	0.2U	0.2U
1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN		0.37J	0.1UJ	0.22J	0.08U	0.8U	0.6U	0.3UJ	0.2UJ
2,3,4,6,7,8-HEXACHLORODIBENZOFURAN		1.8J	0.1UJ	1.3J	0.08U	2J	0.5U	0.79J	0.42J
2,3,4,7,8-PENTACHLORODIBENZOFURAN		0.61J	0.1UJ	0.4J	0.08UJ	0.6U	0.5U	0.3U	0.2U
2,3,7,8-TETRACHLORODIBENZOFURAN		0.75J	0.1UJ	0.48J	0.2J	0.5U	0.4U	0.2U	0.2U
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN		0.08U	0.1UJ	0.21J	0.09U	0.7U	0.5U	0.3U	0.3U
2,3,7,8-TCDD-EQUIVALENT, TOTAL		2.61J	0	1.78J	0.021J	2.00J	0	0.69J	0.14J
PCBs, mg/kg									
AROCLOR-1254		0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
AROCLOR-1260		0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
METALS, mg/kg									
ALUMINUM		14000	10300	13000	24700	19700	21400	18200	19900
ANTIMONY		5.4UJ	6.1UJ	5.7UJ	6J	8.3UJ	7.4UJ	6.9UJ	7.2UJ
ARSENIC		4:4	1.6	4	5	7.4	6.2	6.6	7.4
BARIUM		83.5	63.4	85.5	151	108	109	104	98.2
BERYLLIUM		0.42	0.34	0.49	0.95	0.86	0.86	0.8	0.96
CADMIUM		0.53U	0.59U	0.55U	0.58U	0.81U	0.72U	0.67U	0.7U
CHROMIUM		20.5	14.4	19.2	33.7	32.8	33.9	28.2	31.2
COBALT		8.5	6.3	8.3	13.6	13	12	10.1	11.5
COPPER		16.8	10.5	15.9	32.3	30.3	29.5	26.6	25.6
LEAD		92.8	4.3	47.2	10.6	20.8J	12J	17.9J	11.8J
MANGANESE		372	330	323	652	427	424	380	391
MERCURY		0.05U	0.06U	0.06U	0.07U	0.07U	0.07U	0.07U	0.07U
NICKEL		12.2	9.5	13.5	23	24	27	22	20.2
SELENIUM		0.48UJ	0.54UJ	0.5UJ	0.53UJ	0.74UJ	0.66UJ	0.61UJ	0.63UJ
SILVER		0.62U	0.7U	0.65U	0.69U	0.96U	0.85U	0.79U	0.82U
THALLIUM		0.24	0.27U	0.25	0.4	0.37U	0.43U	0.36U	0.41U
VANADIUM		41.9	32.5	43.3	77.2	63.4	64	54.7	59.9
ZINC		69.1	51.1	69.8	91.6	110	95.5	89.7	93.6

(table continues)

Table 5-5
Analytical Results of Detected Analytes in Soil Samples Collected from IRP Site 4 AOPC 1A

Analyte	Station ID	SB4-01A-13		SB4-01A-14		SB4-01A-15		SB4-01A-16	
	Sample Depth, feet bgs	0 - 1	2 - 2.5	0 - 1	2 - 2.5	0 - 1	2 - 2.5	0 - 1	1.5 - 2
pH									
TOTAL ORGANIC CARBON, %									
PAHs, mg/kg									
ACENAPHTHYLENE		1U	0.1U	0.1U	0.1U	1U	0.1U	0.1U	0.1U
ANTHRACENE		0.1U	0.01U	0.01U	0.01U	0.1U	0.005J	0.01U	0.005J
BENZ(A)ANTHRACENE		0.1U	0.01U	0.004J	0.01U	0.1U	0.02	0.01U	0.01U
BENZO(A)PYRENE		0.1U	0.01U	0.008J	0.01U	0.2U	0.03	0.005J	0.002J
BENZO(B)FLUORANTHENE		0.2U	0.02U	0.02U	0.02U	0.2	0.04	0.02U	0.01J
BENZO(G,H,I)PERYLENE		0.2U	0.02U	0.02U	0.02U	0.09J	0.02	0.02U	0.02U
BENZO(K)FLUORANTHENE		0.1U	0.01U	0.01U	0.01U	0.07J	0.02	0.01U	0.01U
CHRYSENE		0.1U	0.01U	0.005J	0.01U	0.04J	0.02	0.003J	0.01
DIBENZ(A,H)ANTHRACENE		0.1U	0.01U	0.01	0.01U	0.5U	0.01U	0.06U	0.02U
FLUORANTHENE		0.2U	0.02U	0.02U	0.02U	0.2U	0.09	0.02U	0.07
FLUORENE		0.2U	0.02U	0.02U	0.02U	0.2U	0.006J	0.02U	0.006J
INDENO(1,2,3-CD)PYRENE		0.1U	0.01U	0.007J	0.01U	0.1U	0.02	0.003J	0.01U
NAPHTHALENE		1U	0.1U	0.1U	0.1U	1U	0.04J	0.1U	0.1U
PHENANTHRENE		0.1U	0.01U	0.01U	0.01U	0.1U	0.04	0.01U	0.02
PYRENE		0.2U	0.02U	0.005J	0.02U	0.2J	0.09	0.006J	0.01J
PCDDs/PCDFs, pg/g									
1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN		192J	0.5UJ	27.6J	0.5UJ	28.9	65.7	54.3	64.4
1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN		1080J	1.3J	503J	10.3J	933J	666J	1110J	558J
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN		32.1	0.1U	12.8	0.2U	15.3	36.8	38.6	29
1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN		120J	0.3U	72J	0.75J	104	54.9	75.6	45.3
1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN		2J	0.2U	0.83J	0.2U	0.9J	2.4J	0.77J	3.9J
1,2,3,4,7,8-HEXACHLORODIBENZOFURAN		2.2J	0.1U	1.5J	0.1U	1.7J	13.3	1.1J	10.6
1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN		0.94J	0.1U	1.4J	0.2U	0.67J	0.85J	0.2U	0.44J
1,2,3,6,7,8-HEXACHLORODIBENZOFURAN		2J	0.09U	1.3J	0.09U	1.2J	3.6J	0.56J	4.1J
1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN		4.9J	0.2U	3.5J	0.2U	3J	2J	2.1J	1.5J
1,2,3,7,8,9-HEXACHLORODIBENZOFURAN		0.2U	0.1U	0.09U	0.1U	0.1U	0.32J	0.1U	0.41J
1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN		3.3J	0.2U	4.3J	0.2U	2.7J	3.8J	0.91J	1.8J
1,2,3,7,8-PENTACHLORODIBENZOFURAN		0.82J	0.09U	0.81J	0.1U	0.64J	6	0.43J	3.1J
1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN		0.72J	0.07UJ	0.76J	0.1U	0.44J	0.51J	0.09U	0.46J
2,3,4,6,7,8-HEXACHLORODIBENZOFURAN		4.4J	0.1U	2.2J	0.1U	2.7J	3J	0.91J	3.9J
2,3,4,7,8-PENTACHLORODIBENZOFURAN		1.3J	0.09UJ	0.77J	0.1UJ	1.1J	4.3J	0.62J	2.9J
2,3,7,8-TETRACHLORODIBENZOFURAN		1.9	0.17J	1.9	0.1U	1.8	16.8	1.4	8.1
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN		0.28J	0.1U	0.22J	0.1U	0.13J	0.33J	0.12J	0.16J
2,3,7,8-TCDD-EQUIVALENT, TOTAL		6.11J	0.018J	4.02J	0.018J	4.47J	9.07J	3.46J	6.48J
PCBs, mg/kg									
AROCLOR-1254		0.03J	0.1U	0.02J	0.1U	0.4	0.1J	0.2U	0.09J
AROCLOR-1260		0.02J	0.1U	0.1U	0.1U	0.2	0.1U	0.1U	0.03J
METALS, mg/kg									
ALUMINUM		23600	18500	21700	18200	16100	20900	19900	19500
ANTIMONY		7.2UJ	7.3UJ	13UJ	7.5UJ	6UJ	12.7J	7.8J	6.4UJ
ARSENIC		11.7	5.6	7.7	6.7	10.1	8	7.5	4.7
BARIUM		132	99.3	86.3	100	456	134	109	117
BERYLLIUM		0.8	0.61	0.97	0.66	0.56	0.93	0.96	0.72
CADMIUM		0.7U	0.71U	1.3U	0.72U	0.58U	0.59U	0.66U	0.62U
CHROMIUM		39.7	29.3	32.1	25.6	64.5	33.7	41.3	28.9
COBALT		12	11.3	10.5	9.7	9	11.5	12.2	11.5
COPPER		37	22.8	24.5	20.7	64.7	42.7	45.2	27.8
LEAD		83	30.5	101	8.9	3180	43	72.1	27.1
MANGANESE		431	396	328	406	345	414	378	469
MERCURY		0.05U	0.07U	0.14U	0.07U	0.49	0.06U	0.06U	0.06U
NICKEL		28.9	22.5	30.8	18.6	23.2	22.5	22.9	21.7
SELENIUM		0.63UJ	0.64UJ	1.1UJ	0.66UJ	0.53UJ	0.54UJ	0.6UJ	0.56UJ
SILVER		0.82U	0.84U	1.5U	0.85U	0.69U	0.7U	0.77	0.79
THALLIUM		0.32U	0.32U	0.57U	0.36	0.37	0.43	0.3	0.28
VANADIUM		69.8	58.8	71.6	54.9	48.9	61.8	61.2	57.3
ZINC		111	90.2	88.3	75.1	550	153	194	176

(table continues)

Table 5-5
Analytical Results of Detected Analytes
in Soil Samples Collected from IRP Site 4
AOPC 1A

Analyte	Station ID	SB4-01A-17		SB4-01A-18		SB4-01A-19		SB4-01A-20	
	Sample Depth, feet bgs	0 - 1	2 - 2.5	0 - 1	2 - 2.5	0 - 1	2 - 2.5	0 - 1	2 - 2.5
pH									
TOTAL ORGANIC CARBON, %									
PAHs, mg/kg									
ACENAPHTHYLENE		0.1U	0.1U	1U	0.1U	0.1U	0.1U	1U	10U
ANTHRACENE		0.01U	0.01U	0.1U	0.01U	0.01U	0.01U	0.1U	1U
BENZ(A)ANTHRACENE		0.01U	0.01U	0.1U	0.01U	0.01U	0.01U	0.1U	1U
BENZO(A)PYRENE		0.01U	0.003J	0.1U	0.01U	0.01U	0.01U	0.1U	1U
BENZO(B)FLUORANTHENE		0.02U	0.02U	0.05J	0.02U	0.02U	0.02U	0.2U	2U
BENZO(G,H,I)PERYLENE		0.009J	0.02U	0.2U	0.02U	0.02U	0.02U	0.2U	2U
BENZO(K)FLUORANTHENE		0.01U	0.01U	0.1U	0.01U	0.01U	0.01U	0.1U	1U
CHRYSENE		0.01U	0.005J	0.03J	0.01U	0.01U	0.01U	0.1U	1U
DIBENZ(A,H)ANTHRACENE		0.01U	0.02U	0.1U	0.01U	0.01U	0.01U	0.1U	1U
FLUORANTHENE		0.02U	0.02U	0.2U	0.02U	0.02U	0.02U	0.2U	2U
FLUORENE		0.02U	0.02U	0.2U	0.02U	0.02U	0.02U	0.2U	2U
INDENO(1,2,3-CD)PYRENE		0.003J	0.01U	0.1U	0.01U	0.01U	0.01U	0.1U	1U
NAPHTHALENE		0.1U	0.1U	1U	0.1U	0.1U	0.1U	1U	10U
PHENANTHRENE		0.01U		0.1U	0.01U	0.01U	0.01U	0.1U	1U
PYRENE		0.02U	0.007J	0.2U	0.02U	0.02U	0.02U	0.2U	2U
PCDDs/PCDFs, pg/g									
1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN		355J	0.4UJ	96.5J	0.8UJ	1.7J	0.72J	15.8	2.4J
1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN		24120J	23.2J	7540J	49.2J	52	19.3J	557	154J
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN		249	0.4J	83.1	0.2U	1.8J	0.1U	32.6	2.6J
1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN		4150J	3.1J	952	6.4	6.5	2.9J	65	18.5
1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN		25.4	0.2U	5.7	0.2U	0.1U	0.2U	0.48J	0.2U
1,2,3,4,7,8-HEXACHLORODIBENZOFURAN		23.9	0.11U	14.1J	0.09U	0.1U	0.19U	1.4J	0.22U
1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN		19.8J	0.1UJ	8.7J	0.1UJ	0.07UJ	0.1UJ	0.78J	0.35J
1,2,3,6,7,8-HEXACHLORODIBENZOFURAN		14.2	0.08U	30.9	0.09U	0.05U	0.08U	0.92J	0.14J
1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN		75.5	0.1U	29.4	0.1U	0.07U	0.1U	2J	0.62J
1,2,3,7,8,9-HEXACHLORODIBENZOFURAN		1.4J	0.1U	0.2U	0.1U	0.06U	0.1U	0.2U	0.09U
1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN		94.8	0.1U	34.4	0.2U	0.08U	0.1U	2.5J	0.84J
1,2,3,7,8-PENTACHLORODIBENZOFURAN		2.8J	0.1U	3.7J	0.08U	0.06U	0.1U	0.38J	0.09U
1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN		4.8J	0.1U	4.9J	0.09U	0.06U	0.1U	0.44J	0.1U
2,3,4,6,7,8-HEXACHLORODIBENZOFURAN		34.4	0.09U	75.9	0.5J	0.05U	0.28J	1.5J	0.31J
2,3,4,7,8-PENTACHLORODIBENZOFURAN		11.3	0.1U	25	0.09U	0.06U	0.1U	0.83J	0.09U
2,3,7,8-TETRACHLORODIBENZOFURAN		8	0.65J	18.3	0.2J	0.33J	0.09U	1.3	0.41J
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN		0.36J	0.1U	0.42J	0.08U	0.06U	0.1U	0.2U	0.11J
2,3,7,8-TCDD-EQUIVALENT, TOTAL		104J	0.12J	54.8J	0.18J	0.17J	0.077J	3.25J	0.74J
PCBs, mg/kg									
AROCLOR-1254		0.09J	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
AROCLOR-1260		0.07J	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
METALS, mg/kg									
ALUMINUM		33300	32300	22800	17600	26200	23600	26700	19400
ANTIMONY		18J	6.9J	6.8J	6.8UJ	10J	8.2J	9.4J	8UJ
ARSENIC		13.4J	7.1J	10.2J	4.3J	10.8J	5J	4.4J	6J
BARIUM		450	199	720	148	136	174	132	147
BERYLLIUM		1.3	1.2	1.1	0.71	1	0.89	1.1	0.71
CADMIUM		0.61U	0.65U	0.65U	0.66U	0.65U	0.61U	0.77U	0.78U
CHROMIUM		86.2	38.1	73.2	24.9	34.9	31.5	38.1	36.1
COBALT		18.4	16.6	16.4	10.5	13.1	14.8	14.1	13.1
COPPER		64.6J	45.8J	62.9J	19.7J	32.7J	31.3J	30.9J	26.4J
LEAD		398	156	1390	38	35.5	14.8	34.3	41.7
MANGANESE		1310J	1050J	2360J	515J	478J	462J	796J	598J
MERCURY		0.06U	0.07U	0.16U	0.06U	0.06U	0.07U	0.08U	0.12U
NICKEL		33.4	27.2	30.2	16.2	21.8	21.1	27.4	24.4
SELENIUM		0.28UJ	0.3UJ	0.3UJ	0.3UJ	0.3UJ	0.28UJ	0.35UJ	0.35UJ
SILVER		0.72U	0.77U	0.77U	0.78U	0.77U	0.72U	0.92U	0.92U
THALLIUM		0.44J	0.39J	0.3U	0.33J	0.38J	0.31J	0.35J	0.35U
VANADIUM		91.6	88.2	73.5	51.4	72.7	71.9	65.7	59.8
ZINC		239	121	497	77.9	116	105	123	111

(table continues)

Table 5-5
Analytical Results of Detected Analytes in Soil Samples Collected from IRP Site 4 AOPC 1A

Analyte	Station ID	SB4-01A-21		SB4-01A-22	
	Sample Depth, feet bgs	0 - 1	2 - 2.5	0 - 1	2 - 2.5
pH					
TOTAL ORGANIC CARBON, %					
PAHs, mg/kg					
ACENAPHTHYLENE		0.1U	0.1U	1U	0.1U
ANTHRACENE		0.01U	0.01U	0.1U	0.01U
BENZ(A)ANTHRACENE		0.003J	0.01U	0.1U	0.01U
BENZO(A)PYRENE		0.005J	0.01U	0.1U	0.01U
BENZO(B)FLUORANTHENE		0.005J	0.02U	0.2U	0.02U
BENZO(G,H,I)PERYLENE		0.02U	0.02U	0.2U	0.02U
BENZO(K)FLUORANTHENE		0.003J	0.01U	0.1U	0.01U
CHRYSENE		0.005J	0.01U	0.1U	0.01U
DIBENZ(A,H)ANTHRACENE		0.01U	0.01U	0.1U	0.01U
FLUORANTHENE		0.008J	0.02U	0.2U	0.02U
FLUORENE		0.02U	0.02U	0.2U	0.02U
INDENO(1,2,3-CD)PYRENE		0.004J	0.01U	0.1U	0.01U
NAPHTHALENE		0.1U	0.1U	1U	0.1U
PHENANTHRENE		0.01U	0.01U	0.1U	0.01U
PYRENE		0.02J	0.02U	0.2U	0.02U
PCDDs/PCDFs, pg/g					
1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN		4.9J	0.33J	0.3UJ	0.2UJ
1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN		228J	17.8J	13.5J	1.1J
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN		2.3J	0.25J	0.35J	0.09UJ
1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN		34.7J	2.8J	2J	0.1UJ
1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN		0.2UJ	0.2UJ	0.2UJ	0.1UJ
1,2,3,4,7,8-HEXACHLORODIBENZOFURAN		0.56J	0.1UJ	0.1UJ	0.05UJ
1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN		0.27J	0.1UJ	0.2UJ	0.09UJ
1,2,3,6,7,8-HEXACHLORODIBENZOFURAN		0.39J	0.1UJ	0.1UJ	0.05UJ
1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN		0.69J	0.1UJ	0.2UJ	0.09UJ
1,2,3,7,8,9-HEXACHLORODIBENZOFURAN		0.1UJ	0.1UJ	0.2UJ	0.06UJ
1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN		0.96J	0.1UJ	0.2UJ	0.09UJ
1,2,3,7,8-PENTACHLORODIBENZOFURAN		0.35J	0.1UJ	0.2UJ	0.07UJ
1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN		0.24J	0.1UJ	0.1UJ	0.08UJ
2,3,4,6,7,8-HEXACHLORODIBENZOFURAN		0.81J	0.1UJ	0.1UJ	0.05UJ
2,3,4,7,8-PENTACHLORODIBENZOFURAN		0.57J	0.1UJ	0.2UJ	0.07UJ
2,3,7,8-TETRACHLORODIBENZOFURAN		0.8J	0.1UJ	0.2UJ	0.06UJ
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN		0.2UJ	0.2UJ	0.1UJ	0.05UJ
2,3,7,8-TCDD-EQUIVALENT, TOTAL		1.47J	0.049J	0.037J	0.0011J
PCBs, mg/kg					
AROCLOR-1254		0.1U	0.1U	0.1U	0.1U
AROCLOR-1260		0.1UJ	0.1UJ	0.1UJ	0.1UJ
METALS, mg/kg					
ALUMINUM		19000	23200	20600	7830
ANTIMONY		7.8J	7.5UJ	8.3UJ	6.4UJ
ARSENIC		6.3	5.8	6.8	2
BARIUM		138	197	103	51.4
BERYLLIUM		0.7	0.93	0.89	0.37
CADMIUM		0.62U	0.73U	0.81U	0.62U
CHROMIUM		27.1	33.1	34.3	11.8
COBALT		12	15.6	11.9	5.1
COPPER		30.5J	28J	40.5J	6.8J
LEAD		41.5	85	74.4	3.2
MANGANESE		605J	566J	1110J	193J
MERCURY		0.08U	0.06U	0.09U	0.06U
NICKEL		19	23.5	25.5	8.1
SELENIUM		0.28UJ	0.33UJ	0.37UJ	0.28UJ
SILVER		0.74U	1.2	0.95U	0.73U
THALLIUM		0.28U	0.43	0.37U	0.28U
VANADIUM		54.1	71.5	61.4	26.3
ZINC		127	114	156	39.9

(table continues)

Table 5-5 (continued)

AOPC 2A

Analyte	Station ID	SB4-02A-01		SB4-02A-02		SB4-02A-03		SB4-02A-04	
	Sample Depth, feet bgs	0 - 1	2 - 2.5	0 - 1	2 - 2.5	0 - 1	2 - 2.5	0 - 1	2 - 2.5
pH		8.23	8.36	8.64	8.88	8.34	8.37	8.04	8.5
TOTAL ORGANIC CARBON, %		0.41	0.42	0.34	0.35	0.27	0.78		
PAHs, mg/kg									
ACENAPHTHYLENE		0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	10U	0.1U
ANTHRACENE		0.01U	0.003J	0.01U	0.01U	0.01U	0.01U	1U	0.01U
BENZ(A)ANTHRACENE		0.01U	0.02	0.01U	0.01U	0.01U	0.01U	1U	0.01U
BENZO(A)PYRENE		0.01U	0.03	0.01U	0.01U	0.01U	0.01U	1U	0.02
BENZO(B)FLUORANTHENE		0.02J	0.02	0.02U	0.02U	0.02U	0.02U	2UJ	0.03J
BENZO(G,H,I)PERYLENE		0.02U	0.03U	0.02U	0.02U	0.02U	0.02U	2U	0.08
BENZO(K)FLUORANTHENE		0.01U	0.01	0.01U	0.01U	0.01U	0.01U	1U	0.01U
CHRYSENE		0.01U	0.07	0.01U	0.01U	0.01U	0.01U	1U	0.01U
FLUORANTHENE		0.02U	0.02	0.02U	0.02U	0.02U	0.02U	2U	0.02U
INDENO(1,2,3-CD)PYRENE		0.01U	0.01	0.01U	0.01U	0.01U	0.01U	1U	0.02
PHENANTHRENE		0.01U	0.003J	0.01U	0.01U	0.01U	0.01U	1U	0.01U
PYRENE		0.02U	0.04	0.02U	0.02U	0.02U	0.02U	2U	0.02U
PCDDs/PCDFs, pg/g									
1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN		65.2J	4J	1.1UJ	1.4UJ	4.9J	1.6J	1350J	79.6J
1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN		5050J	236J	106J	26.1J	246J	83J	49840J	6300J
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN		45.2	11.3	1.9J	0.95J	8.5	1J	921	58.3
1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN		544	28.2	13.5	2.5J	51.9	7.7	8120J	1040
1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN		1.4U	0.7U	0.4U	0.4U	0.7J	0.4U	88.7	6
1,2,3,4,7,8-HEXACHLORODIBENZOFURAN		9.6	0.77J	0.1U	0.2U	3J	0.1U	114	7.6
1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN		6	0.4U	0.2U	0.4U	1.2J	0.2U	64.2	4.7J
1,2,3,6,7,8-HEXACHLORODIBENZOFURAN		10.7	0.49J	0.1U	0.2U	3.3J	0.1U	41.9	2.8J
1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN		16.3	0.84J	0.2U	0.4U	3.5J	0.2U	279	18.7
1,2,3,7,8,9-HEXACHLORODIBENZOFURAN		0.7U	0.3U	0.2U	0.3U	0.1U	0.2U	5.9	0.44J
1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN		20.9	1.1J	0.2U	0.5U	3.7J	0.3U	321	20.9
1,2,3,7,8-PENTACHLORODIBENZOFURAN		2.1J	0.3U	0.2U	0.3U	0.79J	0.2U	13.4	1.1J
1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN		2.6J	0.5U	0.2U	0.5U	0.91J	0.3U	24.2	1.3J
2,3,4,6,7,8-HEXACHLORODIBENZOFURAN		28.8	1J	0.2U	0.2U	7.4	0.39J	82.2	5.8
2,3,4,7,8-PENTACHLORODIBENZOFURAN		9.9	0.4U	0.2U	0.4U	3.1J	0.2U	53.2	3.1J
2,3,7,8-TETRACHLORODIBENZOFURAN		7.4	0.3U	0.1U	0.3U	3.1	0.1U	103	5.9
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN		0.9U	0.4U	0.1U	0.4U	0.13J	0.2U	1.9	0.3U
2,3,7,8-TCDD-EQUIVALENT, TOTAL		27.3J	1.06J	0.26J	0.061J	5.56J	0.21J	285J	26.4J
PCBs, mg/kg									
AROCLOR-1254		0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	1	0.1
AROCLOR-1260		0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.3	0.02J
METALS, mg/kg									
ALUMINUM		13800	18600	16900	20600	18100	21700	16400	16900
ANTIMONY		5.3UJ	5.5UJ	5.5UJ	11.3J	4.7UJ	5.9UJ	4.8UJ	4.7UJ
ARSENIC		4.3	6.6	3.9	5.5	23.9	7	14.2	4.1
BARIUM		117	129	113	132	123	151	856	228
BERYLLIUM		0.35U	0.66	0.52	0.6	0.62	0.72	0.48	0.6
CADMIUM		0.51U	0.59U	0.58U	0.59U	0.53U	0.75U	0.91U	0.67U
CHROMIUM		20.8	24.8	24.2	27.6	25.7	29.2	134	33.1
COBALT		7.2	10.8	9.2	10.7	10.7	12.3	9.4	9.1
COPPER		15J	20.3J	18.9J	24.3J	20.8J	27.4J	88.6	22.9
LEAD		167	42.8	107	33.1	114J	29.4	3500J	79.2J
MANGANESE		534	664	453	631	457	572	412	445
MERCURY		0.06U	0.06U	0.06U	0.06U	0.06U	0.06U	0.98	0.12U
NICKEL		9.8	13.8	18.3	17	16.1	19.5	20.3	19.6
THALLIUM		0.4U	0.48U	0.31U	0.52U	0.25UJ	0.55U	0.25UJ	0.25UJ
VANADIUM		41.1	54.2	48.2	57.4	51.8	57.6	47.4	51.6
ZINC		79.8	74.6	76.2	145	85.2J	92.9	499J	110J

(table continues)

Table 5-5 (continued)

AOPC 2A

Analyte	Station ID	SB4-02A-05		SB4-02A-06		SB4-02A-07		SB4-02A-08	
	Sample Depth, feet bgs	0 - 1	2 - 2.5	0 - 1	2 - 2.5	0 - 1	2 - 2.5	0 - 1	2 - 2.5
pH		8.43	8.44	8.23	8.11	8.27	8.26	8.11	8.26
TOTAL ORGANIC CARBON, %									
PAHs, mg/kg									
ACENAPHTHYLENE		0.1U	0.05J	10U	0.1U	100U	1U	0.1U	0.1U
ANTHRACENE		0.01U	0.01U	1U	0.01U	10U	0.1U	0.01U	0.01U
BENZ(A)ANTHRACENE		0.01U	0.01U	1U	0.01U	10U	0.1U	0.01U	0.01U
BENZO(A)PYRENE		0.01U	0.01U	0.4J	0.02	10U	0.1U	0.01U	0.01U
BENZO(B)FLUORANTHENE		0.02UJ	0.02UJ	2UJ	0.02UJ	20U	0.2U	0.02U	0.02U
BENZO(G,H,I)PERYLENE		0.04U	0.02U	2U	0.02U	20U	0.2U	0.02U	0.02U
BENZO(K)FLUORANTHENE		0.01U	0.01U	1U	0.01U	10U	0.1U	0.01U	0.01U
CHRYSENE		0.01U	0.01U	1U	0.01U	10U	0.1U	0.01U	0.01U
FLUORANTHENE		0.02U	0.02U	2U	0.02U	20U	0.2U	0.02U	0.02U
INDENO(1,2,3-CD)PYRENE		0.01U	0.01U	1U	0.01U	10U	0.1U	0.01U	0.01U
PHENANTHRENE		0.01U	0.01U	1U	0.01U	10U	0.1U	0.01U	0.01U
PYRENE		0.02U	0.02U	2U	0.02U	20U	0.2U	0.02U	0.02U
PCDDs/PCDFs, pg/g									
1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN		4.6J	5J	129J	2.2J	66.1J	4.2J	2.7J	1.1UJ
1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN		268J	346J	11160J	172J	4510J	198J	97J	8.3J
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN		8.3	5.2	130	2.6J	54.8	5U	4.1U	4.5U
1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN		55.8	55	1400	20.9	504	24.9	19.3	4.7J
1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN		0.64J	0.53J	11.5	0.3U	3.6J	1.2U	0.43U	0.5U
1,2,3,4,7,8-HEXACHLORODIBENZOFURAN		3.1J	1.5J	45.8	0.91J	11.1	2.1U	1.8U	3J
1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN		1.3J	0.64J	14.2	0.2U	4J	1.1J	0.59J	0.49J
1,2,3,6,7,8-HEXACHLORODIBENZOFURAN		3.4J	1.2J	27.2	0.62J	8.1	1.8J	0.95U	1.5J
1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN		3.5J	1.7J	54.6	0.2U	16.1	2.1J	1.3J	1.1J
1,2,3,7,8,9-HEXACHLORODIBENZOFURAN		0.1U	0.1U	0.83J	0.2U	0.29J	0.78J	0.1U	0.2U
1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN		3.8J	2J	45.8	0.2U	13.9	2.1J	1.2J	1.2J
1,2,3,7,8-PENTACHLORODIBENZOFURAN		0.75J	0.42J	5.9	0.23J	1.9J	1.2J	0.66J	1.1J
1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN		0.92J	0.09U	10.2	0.1U	3.1J	1.2J	0.2U	0.39J
2,3,4,6,7,8-HEXACHLORODIBENZOFURAN		7.5	2.1J	63.5	1J	19.4	2.1J	0.79U	1.2J
2,3,4,7,8-PENTACHLORODIBENZOFURAN		3.1J	0.98J	34.2	0.69J	7.2	1.6J	0.73U	1.5J
2,3,7,8-TETRACHLORODIBENZOFURAN		3.1	1.7	48.6	0.9J	4.3	0.83U	1.1U	2.4
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN		0.1U	0.08U	1	0.1U	0.4J	0.21J	0.1U	0.2U
2,3,7,8-TCDD-EQUIVALENT, TOTAL		5.54J	2.55J	80.3J	1.11J	23.6J	3.12J	0.63J	2.14J
PCBs, mg/kg									
AROCLOR-1254		0.1U	0.1U	0.2	0.1U	0.2	0.1U	0.1U	0.1U
AROCLOR-1260		0.1U	0.1U	0.1	0.1U	0.1	0.1U	0.1U	0.1U
METALS, mg/kg									
ALUMINUM		17200	15200	19100	17400	17100	17200	14200	12400
ANTIMONY		4.7UJ	4.9UJ	4.6UJ	4.8UJ			4.9J	
ARSENIC		2.7	2.3	6.6	4.2	4.7	3.6	2.6	3.7
BARIUM		111	95.8	384	135	301	122	102	79
BERYLLIUM		0.56	0.6	0.63	0.56	0.69	0.66	0.58	0.54
CADMIUM		0.59U	0.57U	0.54U	0.57U	0.5U	0.57U	0.54U	0.58U
CHROMIUM		22.2	20.6	46.8	24.8	38.7J	24.7J	18.7J	18.1J
COBALT		9.2	8.7	10.5	11.2	9	11	8.3	8.8
COPPER		17.9	15.2	40.9	19.5	32.4	19.9	17.1	13.8
LEAD		47.4J	6J	1880J	60.4J	971	25.3	9.2	4.9
MANGANESE		487	416	399	787	397	486	376	367
MERCURY		0.06U	0.06U	0.38	0.06U	0.56J	0.13J	0.05UJ	0.06UJ
NICKEL		15.1	14.2	21.7	17.8	16.9	18.8	14.5	13.9
THALLIUM		0.25UJ	0.26UJ	0.24UJ	0.26UJ	0.25	0.28	0.27	0.29
VANADIUM		47.6	48.1	52.5	54.1	45.7	50.8	40.9	39.2
ZINC		70.8	59.8J	451J	85.7J	285J	83.3J	63.9J	58.5J

(table continues)

Table 5-5 (continued)

AOPC 2A

Analyte	Station ID	SB4-02A-09		SB4-02A-10		SB4-02A-11		SB4-02A-12	
	Sample Depth, feet bgs	0 - 1	2 - 2.5	0 - 1	2 - 2.5	0 - 1	2 - 2.5	0 - 1	2 - 2.5
pH									
TOTAL ORGANIC CARBON, %									
PAHs, mg/kg									
ACENAPHTHYLENE		0.1U	0.1U	10U	1U	10U	0.05J	10U	0.04J
ANTHRACENE		0.01U	0.01U	1U	0.1U	1U	0.01U	1U	0.01U
BENZ(A)ANTHRACENE		0.01U	0.01U	1U	0.1U	1U	0.01U	1U	0.01U
BENZO(A)PYRENE		0.01U	0.01U	1U	0.1U	1U	0.01U	1U	0.01U
BENZO(B)FLUORANTHENE		0.02U	0.02U	2U	0.2U	2U	0.02U	2U	0.02U
BENZO(G,H,I)PERYLENE		0.02U	0.02U	2U	0.2U	2U	0.02U	2U	0.02U
BENZO(K)FLUORANTHENE		0.01U	0.01U	1U	0.1U	1U	0.01U	1U	0.01U
CHRYSENE		0.01U	0.01U	1U	0.1U	1U	0.01U	1U	0.01U
FLUORANTHENE		0.02U	0.02U	2UJ	0.2UJ	2UJ	0.02UJ	2UJ	0.02UJ
INDENO(1,2,3-CD)PYRENE		0.01U	0.01U	1U	0.1U	1U	0.01U	1U	0.01U
PHENANTHRENE		0.01U	0.01U	1U	0.1U	1U	0.01U	1U	0.01U
PYRENE		0.02U	0.02U	2U	0.2U	2U	0.02U	2U	0.02U
PCDDs/PCDFs, pg/g									
1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN		11.1J	0.3UJ	167	2J	57.3	2U	90.1J	0.3UJ
1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN		437J	4.4J	8780J	114	3410J	23.8J	5230J	9.8J
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN		9.3	0.1U	58.7	0.73U	40.4	0.6U	41.7J	0.37U
1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN		99.5J	0.8J	618J	6.9	411J	2.3J	542J	1.1J
1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN		0.79J	0.1U	5.9J	0.2U	4.4J	0.9UJ	4.2J	0.1U
1,2,3,4,7,8-HEXACHLORODIBENZOFURAN		2.6J	0.06U	3.9J	0.07U	13.3	0.5U	4.2J	0.06U
1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN		1.6J	0.09U	3.1J	0.1U	4.8J	0.6UJ	3.8J	0.08U
1,2,3,6,7,8-HEXACHLORODIBENZOFURAN		2.7J	0.06U	2.5J	0.07U	9.7	0.4U	2.1J	0.06U
1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN		5.1	0.1U	16.5	0.1U	17.4	0.6U	14.7J	0.08U
1,2,3,7,8,9-HEXACHLORODIBENZOFURAN		0.1U	0.07U	0.06U	0.08U	0.6UJ	0.6UJ	0.4UJ	0.07U
1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN		6.7	0.1U	10.2	0.1U	14.4	0.6U	13.1J	0.09U
1,2,3,7,8-PENTACHLORODIBENZOFURAN		0.97J	0.07U	0.83J	0.08U	1.7J	0.5U	0.4UJ	0.06U
1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN		0.91J	0.06U	1.8J	0.08U	4.6J	0.6U	1.7J	0.07U
2,3,4,6,7,8-HEXACHLORODIBENZOFURAN		6.8	0.06U	7.6	0.07U	35	0.5U	5.6J	0.06U
2,3,4,7,8-PENTACHLORODIBENZOFURAN		2.4J	0.07UJ	1.8J	0.08U	10.8	0.5U	2.6UJ	0.06U
2,3,7,8-TETRACHLORODIBENZOFURAN		2.4	0.07U	2	0.07U	9.3	0.4U	2.1J	0.24U
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN		0.07U	0.15J	0.25J	0.07U	0.5U	0.6U	0.4UJ	0.07J
2,3,7,8-TCDD-EQUIVALENT, TOTAL		6.04J	0.16J	22.4J	0.19J	26.2J	0.047J	16.6J	0.091J
PCBs, mg/kg									
AROCLOR-1254		0.1U	0.1U	0.03J	0.1U	0.07J	0.1U	0.04J	0.1U
AROCLOR-1260		0.1U	0.1U	0.07J	0.03J	0.09J	0.1U	0.05J	0.1U
METALS, mg/kg									
ALUMINUM		16700	15700	13800	15200	14100	12000	13100	12900
ANTIMONY		5.6UJ	6UJ	4.7UJ	5UJ	5.1UJ	5.6UJ	4.9UJ	5.3UJ
ARSENIC		3.4	3.1	6.5	4.3	3.7	3.1	6.2	2.7
BARIUM		111	106	220	142	229	79.8	158	81.2
BERYLLIUM		0.6	0.54	0.54	0.61	0.51	0.49U	0.45U	0.64
CADMIUM		0.54U	0.58U	0.46U	0.49U	0.49U	0.54U	0.47U	0.51U
CHROMIUM		22.5	23.1	45.5	28.6	34.8	17.4	31.8	18
COBALT		9.8	8.8	8.1	9.2	8.1	7.6	7.5	7.2
COPPER		19.7	15.6	34	26.5	26.9	14.6	22.7	13.2
LEAD		24.4	6	211J	309J	814J	14.5J	243J	8.3J
MANGANESE		463	391	423	475	420	348	373	397
MERCURY		0.06U	0.05U	0.22	0.13	0.32	0.05U	0.16	0.06U
NICKEL		15.5	14.1	18.6	16.3	14.9	11.1	16.8	12.6
THALLIUM		0.25	0.34	0.23U	0.24U	0.29U	0.27U	0.28U	0.25U
VANADIUM		45.5	48	42	44.3	39.2	38.2	37.9	38.4
ZINC		77.3	68.5	204	94.9	220	56.9	158	51.1

(table continues)

Table 5-5 (continued)

AOPC 2A

Analyte	Station ID	SB4-02A-13		SB4-02A-14		SB4-02A-15		SB4-02A-16	
	Sample Depth, feet bgs	0 - 1	2 - 2.5	0 - 1	2 - 2.5	0 - 1	2 - 2.5	0 - 1	2 - 2.5
pH									
TOTAL ORGANIC CARBON, %									
PAHs, mg/kg									
ACENAPHTHYLENE		10U	1U	10U	1U	10U	1U	10U	0.1U
ANTHRACENE		1U	0.1U	1U	0.1U	1U	0.1U	1U	0.01U
BENZ(A)ANTHRACENE		1U	0.1U	1U	0.1U	1U	0.1U	1U	0.01U
BENZO(A)PYRENE		1U	0.1U	1U	0.1U	1U	0.1U	1U	0.01U
BENZO(B)FLUORANTHENE		2U	0.2U	2U	0.2U	2U	0.2U	2U	0.02U
BENZO(G,H,I)PERYLENE		2U	0.2U	2U	0.2U	2U	0.2U	2U	0.02U
BENZO(K)FLUORANTHENE		1U	0.1U	1U	0.1U	1U	0.1U	1U	0.01U
CHRYSENE		1U	0.1U	1U	0.1U	1U	0.1U	1U	0.01U
FLUORANTHENE		2UJ	0.2UJ	2UJ	0.2UJ	2UJ	0.2UJ	2U	0.02U
INDENO(1,2,3-CD)PYRENE		1U	0.1U	1U	0.1U	1U	0.1U	1U	0.01U
PHENANTHRENE		1U	0.1U	1U	0.1U	1U	0.1U	1U	0.01U
PYRENE		2U	0.2U	2U	0.2U	2U	0.2U	2U	0.02U
PCDDs/PCDFs, pg/g									
1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN		59.2J	0.5UJ	55J	0.98J	110J	0.3UJ	90.8J	0.6UJ
1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN		3690J	4.3J	3400J	22.6J	9360J	7J	7250J	3.1J
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN		31.4	0.1U	21.7	0.35U	74.8	0.1U	39.8	0.2U
1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN		378	0.2U	270J	1.3J	970	0.61J	527	0.4U
1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN		2.9J	0.2U	2J	0.2UJ	7.1	0.2U	3.2J	0.3U
1,2,3,4,7,8-HEXACHLORODIBENZOFURAN		6	0.08U	2U	0.15U	13.3	0.08U	3.2J	0.1U
1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN		2.6J	0.1U	1.7J	0.09U	5.7	0.1U	2.4J	0.2UJ
1,2,3,6,7,8-HEXACHLORODIBENZOFURAN		5	0.07U	1.3J	0.06U	10.1	0.08U	2.4J	0.1U
1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN		11	0.1U	7.8	0.08U	24.8	0.1U	12.8	0.2U
1,2,3,7,8,9-HEXACHLORODIBENZOFURAN		0.27J	0.09U	0.1U	0.08U	0.2U	0.09U	0.2U	0.2U
1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN		9.2	0.1U	5.5	0.1U	21.3	0.1U	8.8	0.64J
1,2,3,7,8-PENTACHLORODIBENZOFURAN		1.7J	0.08U	0.39J	0.06U	3.7J	0.08U	0.78J	0.07U
1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN		1.7J	0.09U	0.87J	0.06U	3.3J	0.08U	1.3J	0.1UJ
2,3,4,6,7,8-HEXACHLORODIBENZOFURAN		13.4	0.08U	3.3J	0.07U	26.7	0.08U	5.1	0.1U
2,3,4,7,8-PENTACHLORODIBENZOFURAN		4.1J	0.08U	1J	0.06U	9.6	0.08U	2.1J	0.08U
2,3,7,8-TETRACHLORODIBENZOFURAN		2.3	0.08U	0.96U	0.2U	7.4	0.22U	1.4	0.08U
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN		0.27J	0.1U	0.25J	0.06U	0.49J	0.09U	0.25J	0.08U
2,3,7,8-TCDD-EQUIVALENT, TOTAL		16.1J	0.0043J	9.56J	0.037J	38.0J	0.013J	18.6J	0.067J
PCBs, mg/kg									
AROCLOR-1254		0.1U	0.1U	0.02J	0.1U	0.07J	0.1U	0.03J	0.1U
AROCLOR-1260		0.03J	0.1U	0.04J	0.1U	0.1	0.1U	0.1	0.1U
METALS, mg/kg									
ALUMINUM		10200	12000	13200	10300	15000	19500	12400	18400
ANTIMONY		5UJ	5.3UJ	4.8UJ	4.8UJ	5.1UJ	5.6J	5.1UJ	5.2UJ
ARSENIC		2.5	1.9	4.7	2.7	5.7	6.4	7.1	2.7
BARIUM		101	84.1	112	74.1	359	116	173	163
BERYLLIUM		0.33U	0.37U	0.49U	0.35U	0.54	0.81	0.54U	0.72U
CADMIUM		0.48U	0.52U	0.47U	0.47U	0.49U	0.52U	0.52	0.51U
CHROMIUM		20.3	17.9	23.8	15.5	53.7	26.8	30	22.7
COBALT		5.8	6.8	7.3	6.2	9.3	9.8	7.6	9.2
COPPER		12.6	12.5	18.6	11.9	41.5	21.7	21.5	26.1
LEAD		253J	14.8J	148J	16.5J	1820J	61.1J	391J	10.1J
MANGANESE		288	330	379	321	476	528	371	579
MERCURY		0.05U	0.06U	0.11	0.05U	0.47	0.06U	0.39	0.06U
NICKEL		10.2	12.4	12.3	10.3	19.7	18	13.3	16
THALLIUM		0.24U	0.31U	0.28U	0.32U	0.27U	0.33U	0.38U	0.42U
VANADIUM		28.6	36.5	38	31.2	43.8	55.2	36.4	46.4
ZINC		164	62.4	86.3	49.4	342	79	139J	63J

(table continues)

Table 5-5 (continued)

AOPC 2A

Analyte	Station ID	SB4-02A-17	
	Sample Depth, feet bgs	0 - 1	2 - 2.5
pH			
TOTAL ORGANIC CARBON, %			
PAHs, mg/kg			
ACENAPHTHYLENE		10U	0.04J
ANTHRACENE		1U	0.01U
BENZ(A)ANTHRACENE		1U	0.01U
BENZO(A)PYRENE		1U	0.01U
BENZO(B)FLUORANTHENE		2U	0.02U
BENZO(G,H,I)PERYLENE		2U	0.02U
BENZO(K)FLUORANTHENE		1U	0.01U
CHRYSENE		1U	0.01U
FLUORANTHENE		2U	0.02U
INDENO(1,2,3-CD)PYRENE		1U	0.01U
PHENANTHRENE		1U	0.01U
PYRENE		2U	0.02U
PCDDs/PCDFs, pg/g			
1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN		168J	2.5J
1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN		13930J	141J
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN		130	2.4J
1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN		1740	14.2
1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN		11.3	0.7U
1,2,3,4,7,8-HEXACHLORODIBENZOFURAN		23.7	0.62J
1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN		11.2J	0.4UJ
1,2,3,6,7,8-HEXACHLORODIBENZOFURAN		18.4	0.3U
1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN		45	0.4U
1,2,3,7,8,9-HEXACHLORODIBENZOFURAN		0.6J	0.4U
1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN		42.3	0.4U
1,2,3,7,8-PENTACHLORODIBENZOFURAN		4.6	0.2U
1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN		5.7J	0.2UJ
2,3,4,6,7,8-HEXACHLORODIBENZOFURAN		45.7	0.38J
2,3,4,7,8-PENTACHLORODIBENZOFURAN		16.9	0.2U
2,3,7,8-TETRACHLORODIBENZOFURAN		13.4	0.22J
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN		0.58J	0.2U
2,3,7,8-TCDD-EQUIVALENT, TOTAL		65.1J	0.43J
PCBs, mg/kg			
AROCLOR-1254		0.2	0.1U
AROCLOR-1260		0.2	0.1U
METALS, mg/kg			
ALUMINUM		15200	13200
ANTIMONY		5.2UJ	5.2UJ
ARSENIC		5.2	1.3
BARIUM		383	84
BERYLLIUM		0.65U	0.57U
CADMIUM		0.91	0.51U
CHROMIUM		62.1	18.9
COBALT		9.4	7.4
COPPER		43.9	12.9
LEAD		1370J	18.7J
MANGANESE		499	379
MERCURY		1.1	0.06U
NICKEL		18.5	11.4
THALLIUM		0.41U	0.34U
VANADIUM		44.2	39.1
ZINC		440J	63.4J

(table continues)

Table 5-9
Analytical Results of Detected Analytes
in Groundwater Samples Collected from IRP Site 4
AOPC 1A

Analyte	Station ID	HP4-01A-01	HP4-01A-02	HP4-01A-03
	Sample Depth, feet bgs	5 - 8	6 - 9	7 - 10
PCDDs/PCDFs, pg/L				
1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN		7.6J	9.1UJ	17.8UJ
2,3,7,8-TCDD[1]-EQUIVALENT, TOTAL		0.0076J	0	0
METALS, µg/L				
ANTIMONY		26.5	49.9	61.1
BARIUM		69.4J	157	82.6
CADMIUM		2.5	2.2U	2.2U
MANGANESE		7440J	1580	4880
SELENIUM		16.2J		23J
VANADIUM		8.7	13.5	11.2
CHROMIUM, HEXAVALENT		0.336UJ	0.993UJ	9.5J
WATER QUALITY PARAMETERS, mg/L				
SOLIDS, TOTAL DISSOLVED		50500J	36700J	42600J
ALKALINITY*		724	1260	730
CHLORIDE		26600	22500	25000
NITRATE		0.07J	0.2UJ	0.2U
PHOSPHATE		0.55	0.22J	0.06J
SULFATE		3630	1520	2960

(table continues)

Table 5-9 (continued)

AOPC 2A

Analyte	Station ID / Sample Depth, feet bgs	HP4-02A-01 9 - 12	HP4-02A-02 9 - 12	HP4-02A-03 10 - 13
PCDDs/PCDFs, pg/L				
1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN		3.3UJ	11.1J	5.8UJ
1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN		10.1J	11.9U	7.9J
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN		1.2U	2.2U	1.5J
1,2,3,4,7,8-HEXACHLORODIBENZOFURAN		1.4J	1.3U	0.7U
2,3,7,8-TETRACHLORODIBENZOFURAN		1.9J	2.4J	0.8U
2,3,7,8-TCDD-EQUIVALENT, TOTAL		0.34J	0.25J	0.023J
METALS, µg/L				
ANTIMONY		32.1	39.2	46
ARSENIC		36J	5UJ	5UJ
BARIUM		377J	153	71.8
CADMIUM		3.3	3.6	2.2U
MANGANESE		1810J	6240	820
SELENIUM		15.3		15.5J
VANADIUM		8.9	16.2	27.5
ZINC		1.7	1.4U	3.2U
CHROMIUM, HEXAVALENT		0.6U	1.86UJ	2.41J
WATER QUALITY PARAMETERS, mg/L				
SOLIDS, TOTAL DISSOLVED		35500J	57800J	29600J
ALKALINITY*		1450	558	1600
CHLORIDE		20900	34300	14500
NITRATE		0.04J	0.2U	1.7
PHOSPHATE		0.8	0.12	0.22
SULFATE		1120	4290	3970

(table continues)

Table 5-9 (continued)

Note: *alkalinity reported as calcium carbonate

Acronyms/Abbreviations:

AOPC - area of potential concern
bgs - below ground surface
IRP - Installation Restoration Program
J - reported value is estimated
mg/L - milligrams per liter
µg/L - micrograms per liter
PCDD - polychlorinated dibenzodioxin
PCDF - polychlorinated dibenzofuran
pg/L - picograms per liter
TCDD - tetrachlorodibenzo-p-dioxin
U - not detected above the reported sample quantitation limit
UJ - not detected above the estimated sample quantitation limit

Attachment C
Review Comments by Department of Toxic Substances Control (27 June 03), Regional Water Quality Control Board, Santa Ana Region (17 June 03), and the City of Seal Beach (16 June 03); and Response to Comments

Project Note

Date issued:	28 July 2003
Recorded by:	Marielle Coquia/CH2M HILL
Project Number:	171335.24.EE
Subject:	Responses to the 23 June 2003 James M. Polisini, Department of Toxic Substances Control Comments Re: *Draft Addendum to the Engineering Evaluation/Cost Analysis (EE/CA), Non-Time Critical Removal Action for Site 7, Site 4 Areas of Potential Concern (AOPCs) 1A and 2A, Naval Station Landfill, U.S. Naval Weapons Station, Seal Beach* Responses to the 17 June 2003 John Broderick, California Regional Water Quality Control Board, Santa Ana Region Comments Re: Appendix F, *Draft Addendum to the Engineering Evaluation/Cost Analysis (EE/CA), Non-Time Critical Removal Action for Site 7, Site 4 Areas of Potential Concern (AOPCs) 1A and 2A, Naval Station Landfill, U.S. Naval Weapons Station, Seal Beach* Responses to the 16 June 2003 Lee Whittenberg, City of Seal Beach Comments Re: *Draft Addendum to the Engineering Evaluation/Cost Analysis (EE/CA), Non-Time Critical Removal Action for Site 7, Site 4 Areas of Potential Concern (AOPCs) 1A and 2A, Naval Station Landfill, U.S. Naval Weapons Station, Seal Beach*

Response to Comments 23 June 2003 by James M. Polisini, Department of Toxic Substances Control

GENERAL COMMENTS

HERD has limited comments centering on the application of the proposed Ecological Remedial Action Objective (ERAO).

Response

Comment noted.

SPECIFIC COMMENTS

Comment

1. While it has no impact on the implementation of the Site 4 EE/CA activities, please explain what limited recreational activities are authorized for military and retired military personnel in the NWR (Section F2.1.6, page F2-7).

Response

The limited recreational activities refer to sailing of small boats in the lower estuaries of the Seal Beach National Wildlife Refuge. Note that this will not result in a change to the text of the report, and is provided for information purposes only.

Comment

2. In a February 5, 2003 telephone discussion with Navy contractors, HERD agreed to the methodology used for Site 4 AOPCs as Site 4 specific (Section F2.5.1.2). However, HERD does not categorically agree that an adverse effect level of 20 percent, based on a Lowest Observable Adverse Effect Level (LOAEL) on individual adverse effects, is indicative of the level at which wildlife populations are adversely affected (Section F2.5.1.2, page F2-13). Extrapolation from individual effects to population effects is extremely complex, dependent on many factors such as whether a species is an r-selected or k-selected species. This comment is meant only to clarify HERD's general policy and no response is required.

Response

Comment noted.

Comment

3. The cumulative frequency plot provided for the existing soil lead concentrations (Figure F2-3) was extremely helpful in support of the proposed ERAO of 600 mg/kg lead. The Navy should consider a similar presentation when developing ERAOs for NWS Seal Beach or other facilities.

Response

Comment noted.

Comment

4. The implementation of the 600 mg/kg ERAO does not appear to involve the limitations HERD recommended. The 600 mg/kg lead in soil is meant to be a not-to-exceed concentration. The average of the soil lead concentration remaining should be reasonably similar to the mean and median values presented in the documentation used to develop the ERAO of 600 mg/kg. Here is the language transmitted by HERD in a March 14, 2003 memorandum regarding the implementation of this ERAO:

   The proposed ERAO for Site 4 Area 1A and 2A of 600 mg/kg lead is acceptable for this site. Based on the draft submittals, regarding the potential ecological hazard to upper trophic level receptors based on Lowest Observable Adverse Effect Levels (LOAELs), forwarded for review (Appendix A, this memorandum) this acceptance is based on the following:

   A. Based on the samples currently available, removal or remediation of material in Area 1A and 2A, exceeding 600 mg/kg lead would result in an arithmetic average lead soil concentration of approximately 80 mg/kg.

B. Site 4 is the linear perimeter road at Seal Beach. It is much more likely, given the proximity of the National Wildlife Refuge (NWR) that receptors would preferentially forage in areas of the NWR as opposed to the perimeter road and the boundary of the perimeter road. Incremental exposure from Site 4 would therefore be further reduced.

C. Post-remediation confirmation sampling should be required to determine the lead concentration following remedial action is less than a maximum of 600 mg/kg with an area-wide arithmetic average in Area 1A and Area 2A of less than 100 mg/kg. The statement of the ERAO should indicate these criteria.

D. The not-to-exceed 600 mg/kg maximum and 100 mg/kg average concentration for lead should apply to all depths which could reasonably be accessible to ecological receptors along the berm of the Perimeter Road. Guidance on the depth to which ecological receptors may be exposed to soil contamination is available on the HERD website at http://www.dtsc.ca.gov/Science Technology/eco.html.

The statement of Removal Action Objectives (Section F3.4, page F3-4) do not make the explicit statement that the 600 mg/kg soil lead is a not-to-exceed concentration. Neither is the requirement that the arithmetic average of the soil lead concentration in the confirmation samples should not exceed 100 mg/kg, which is a safety factor of 2.5 times the arithmetic average of the data set used to develop the 600 mg/kg ERAO. The arithmetic average condition should be included in the Remedial Action Objective section. Sampling results from the data set used to develop the ERAO can be used in concert with the confirmation sampling results if those locations are not excavated or impacted by the removal action. Once the confirmation sampling results are available HERD will be available to meet with the Navy to evaluate the confirmation sampling results.

Response

In response to DTSC's comments, the following revisions will be made to the EE/CA document to clarify the ERAO and the limitations recommended by DTSC/HERD (note that the bold text indicates added text):

1) The first sentence of the last paragraph on Page F2-14 will be clarified by revising the sentence to read: "..., a site-specific maximum TCG of 600 mg/kg **for lead** is proposed."

2) The following sentence will be inserted following the first sentence of the last paragraph on Page F2-14: "**This is in addition to an area-wide arithmetic average TCG of less than 100 mg/kg for lead in soils for Site 4 AOPCs 1A and 2A.**"

3) The sixth sentence of the last paragraph on Page F2-14 will be revised to read: "Thus, remediation to **a maximum** TCG of 600 mg/kg for lead **with an area-wide arithmetic average TCG of less than 100 mg/kg for lead** is expected to virtually eliminate risks from lead to wildlife in Site 4."

4) First sentence of first paragraph on Page F2-19 will be revised to read: " A site-specific maximum TCG of 600 mg/kg **for lead**..."

5) Fourth sentence of first paragraph on Page F2-19 will be revised to read: " ..., plus the final site-specific **maximum** TCG of 600 mg/kg **for lead**..."

6) Third sentence of the first paragraph after the bullet list on Page F3-4 will be revised to read: "For Site 4 AOPCs 1A and 2A, a site-specific **maximum** TCG of 600 mg/kg for lead **coupled with an area-wide arithmetic average TCG of less than 100 mg/kg for lead were** developed based on..."

Response to Comments 17 June 2003 by John Broderick, California Regional Water Quality Control Board, Santa Ana Region

COMMENT

F2.5.2 Health and Environmental Effects Associated with Chemicals of Concern and Threat to Nearby Human Populations and Environment, F2.5.2.1 Lead, Page F2-19: For the nearby 880-acre Bolsa Chica coastal wetlands restoration project, the site lead LCI T50 is 96 mg/kg and twice the ERM is 654 mg/kg.

Response

Comment noted and was provided to the Navy for informational purposes only. No change to the text is required.

Response to Comments 16 June 2003 by Lee Whittenberg, Director of Development Services, City of Seal Beach

COMMENT

The City of Seal Beach concurs with the determination of the Navy to implement Alternative 2. "Excavation and Offsite Removal". The proposed removal action offers a high degree of protectiveness for human health and the environment by removing the lead-contaminated soils from Site 4 AOPCs 1A and 2A, which pose a risk to ecological receptors. This alternative will:

- ❑ Adequately protects public health and safety and the environment
- ❑ Complies with "Applicable or Relevant and Appropriate Requirements" (ARARs)
- ❑ Meets the "Removal Action Objectives" (RAOs)
- ❑ Provide short-term effectiveness because of low impacts on the community, workers, and the environment
- ❑ Provides high technical feasibility and low administrative requirements
- ❑ Provides high reasonableness of costs, offering the highest benefit in terms of achieving the RAOs for the estimated cost.

The City of Seal Beach also concurs with the "target cleanup goal" (TCG) level. The City understands that the TCG has been reviewed and approved by the Human and Ecological Risk Division of the California Department of Toxic Substances Control (DTSC). Additionally, DTSC has stated that the human health risk did not appear to be an issue, particularly due to the low exposure related to intermittent travel on the perimeter road.

Response

Comment noted and was provided to the Navy for informational purposes only. No change to the text is required.

Department of Toxic Substances Control

Edwin F. Lowry, Director
5796 Corporate Avenue
Cypress, California 90630

Winston H. Hickox
Agency Secretary
California Environmental
Protection Agency

Gray Davis
Governor

OPTIONAL FORM 99 (7-90)

FAX TRANSMITTAL # of pages ▶ 2

To BRANT WONG	From SI HE
Dept./Agency	Phone # (619) 532-1235
Fax # (714) 424-2065	Fax #

NSN 7540-01-317-7368 5099-101 GENERAL SERVICES ADMINISTRATION

June 27, 2003

Ms. Pei-Fen Tamashiro
Naval Weapons Station, Seal Beach
800 Seal Beach Boulevard
Seal Beach, California 90740-5000

REVIEW OF THE DRAFT ADDENDUM TO THE ENGINEERING EVALUATION/COST ANALYSIS (EE/CA), NON-TIME CRITICAL REMOVAL ACTION FOR SITE 7, SITE 4 AREAS OF POTENTIAL CONCERN (AOPCs) 1A AND 2A, NAVAL WEAPONS STATION, SEAL BEACH, CALIFORNIA, DATED May 21, 2003

Dear Ms.Tamashiro:

The Department of Toxic Substances Control (DTSC) has reviewed the subject document prepared by CH2MHILL, for the Department of Navy (DON), Southwest Division, Naval Facilities Engineering Command. Upon review, DTSC has enclosed comments.

If you have any questions, please call me at (714) 484-5446.

Sincerely,

Katherine Leibel
Remedial Project Manager
Federal Facilities Unit B
Office of Military Facilities
Southern California Region

Enclosure

cc: See next page.

cc: Mr. Si Le
Remedial Project Manager
SWDIV Naval Facilities Engineering Command
1220 Pacific Coast Highway
San Diego, California 92132-5190

Department of Toxic Substances Control

Winston H. Hickox
Agency Secretary
California Environmental
Protection Agency

Edwin F. Lowry, Director
5796 Corporate Avenue
Cypress, California 90630

Gray Davis
Governor

TO: Katherine Leibel, DTSC Project Manager
Office of Military Facilities - Cypress Office
5796 Corporate Avenue
Cypress, CA 90630

FROM: James M. Polisini, Ph.D.
Staff Toxicologist, HERD
1011 North Grandview Avenue
Glendale, CA 91201

DATE: June 23, 2003

SUBJECT: SEAL BEACH NAVAL WEAPONS STATION SITE 4 EE/CA
[SITE 400136-47 PCA 14740 H:16]

BACKGROUND

HERD has reviewed the document titled *Appendix F, Draft Addendum to the Engineering Evaluation/Cost Analysis (EE/CA) Non-Time Critical Removal Action for Site 7, Site 4 Areas of Potential Concern (AOPCs) 1A and 2A, Naval Weapons Station Seal Beach, Seal Beach, California*. This undated document is meant to be an appendix to the Final EE/CA, Non-Time Critical Removal Action for Site 7. Inclusion of this appendix into the Final EE/CA for Site 7 will allow the non-time critical removal action for Site 4 AOPCs to be performed at the same time as the non-time critical removal action at Site 7. Site 4 and Site 7 are in close proximity. This appendix was prepared by CH2MHill of Santa Ana, California.

Site 4 consists of the Perimeter Road and adjacent areas that extend around Naval Weapons Station (NWS) Seal Beach for a total of approximately 12 miles. The southwest portion of the Perimeter Road, along Edinger Avenue, is located adjacent to the Seal Beach National Wildlife Refuge (NWR) and the Site 7 Station Landfill. This stretch of the Perimeter Road is the location of Site 4 AOPC 1A and 2A, which extend northward from the Perimeter Road approximately 100 feet. The main contaminant of concern at Site 4 AOPCs is lead in soil apparently from the application of waste oil for dust suppression from the mid-1960s to 1973. Oil was applied one to three times per year. From 1972 to 1973 an estimated 40,000 gallons of waste oil, generated at off-site crude oil and

petroleum operations, were sprayed on the Perimeter Road. Since early 1974 the Perimeter Road has been sprayed with quality-controlled penetrating oil consisting of 70 percent water and 30 percent emulsified agent.

NWS Seal Beach is located approximately 26 miles south of the Los Angeles urban center and consists of about 5000 acres of land along the Pacific Ocean within the city of Seal Beach in Orange County, California. Naval Weapons Station (NWS) Seal Beach is bordered on the southwest by Anaheim Bay, to the north, east and west by Long Beach, Seal Beach, Los Alamitos, Westminster and Huntington Beach. Anaheim Bay and the associated salt marsh were designated a National Wildlife Refuge (NWR) in 1964. On August 30, 1972, 200 additional upland acres were added to the NWR.

GENERAL COMMENTS

HERD has limited comments centering on the application of the proposed Ecological Remedial Action Objective (ERAO).

SPECIFIC COMMENTS

1. While it has no impact on the implementation of the Site 4 EE/CA activities, please explain what 'limited recreational activities are authorized' for military and retired military personnel in the NWR (Section F2.1.6, page F2-7).

2. In a February 5, 2003 telephone discussion with Navy contractors, HERD agreed to the methodology used for Site 4 AOPCs as Site 4 specific (Section F2.5.1.2). However, HERD does not categorically agree that an adverse effect level of 20 percent, based on a Lowest Observable Adverse Effect Level (LOAEL) on individual adverse effects, is indicative of the level at which wildlife populations are adversely affected (Section F2.5.1.2, page F2-13). Extrapolation from individual effects to population effects is extremely complex, dependent on many factors such as whether a species is an r-selected or k-selected species. This comment is meant only to clarify HERD's general policy and no response is required.

3. The cumulative frequency plot provided for the existing soil lead concentrations (Figure F2-3) was extremely helpful in support of the proposed ERAO of 600 mg/kg lead. The Navy should consider a similar presentation when developing ERAOs for NWS Seal Beach or other facilities.

4. The implementation of the 600 mg/kg ERAO does not appear to involve the limitations HERD recommended. The 600 mg/kg lead in soil is meant to be a not-to-exceed concentration. The average of the soil lead concentration remaining should be reasonably similar to the mean and median values presented in the documentation used to develop the ERAO of 600 mg/kg. Here is the language transmitted by HERD in a March 14, 2003 memorandum regarding the implementation of this ERAO:

   The proposed ERAO for Site 4 Area 1A and 2A of 600 mg/kg lead is acceptable for this site. Based on the draft submittals, regarding the potential ecological hazard to upper trophic level receptors based on Lowest Observable Adverse Effect Levels (LOAELs), forwarded for review (Appendix A, this memorandum) this acceptance is based on the following:

   A. Based on the samples currently available, removal or remediation of material in Area 1A and 2A exceeding 600 mg/kg lead would result in an arithmetic average lead soil concentration of approximately 80 mg/kg.
   B. Site 4 is the linear perimeter road at Seal Beach. It is much more likely, given the proximity of the National Wildlife Refuge (NWR) that receptors would preferentially forage in areas of the NWR as opposed to the perimeter road and the boundary of the perimeter road. Incremental exposure from Site 4 would therefore be further reduced.
   C. Post-remediation confirmation sampling should be required to determine the lead concentration following remedial action is less than a maximum of 600 mg/kg with an area-wide arithmetic average in Area 1A and Area 2A of less than 100 mg/kg. The statement of the ERAO should indicate these criteria.
   D. The not-to-exceed 600 mg/kg maximum and 100 mg/kg average concentration for lead should apply to all depths which could reasonably be accessible to ecological receptors along the berm of the Perimeter Road. Guidance on the depth to which ecological receptors may be exposed to soil contamination is available on the HERD web site at http://www.dtsc.ca.gov/ScienceTechnology/eco.html.

   The statement of Removal Action Objectives (Section F3.4, page F3-4) do not make the explicit statement that the 600 mg/kg soil lead is a not-to-exceed concentration. Neither is the requirement that the arithmetic average of the soil lead concentration in the confirmation samples should not exceed 100 mg/kg, which is a safety factor of 2.5 times the arithmetic average of the data set

used to develop the 600 mg/kg ERAO. The arithmetic average condition should be included in the Remedial Action Objective section. Sampling results from the data set used to develop the ERAO can be used in concert with the confirmation sampling results if those locations are not excavated or impacted by the removal action. Once the confirmation sampling results are available HERD will be available to meet with the Navy to evaluate the confirmation sampling results.

CONCLUSIONS

HERD has one substantive comment on the Site 4 EE/CA. The condition that confirmation samples should be evaluated on a not-to-exceed 600 mg/kg soil lead, as HERD agreed, is included. However, the additional criterion that the arithmetic average of the soil lead concentration should not exceed 100 mg/kg in confirmation samples is not included. This latter arithmetic average condition should be included in Section F3.4.

Once the confirmation sampling results are available HERD will be available to meet with the Navy to evaluate the confirmation sampling results.

HERD Internal Reviewer: Brian K. Davis, Ph.D.
Staff Toxicologist, HERD

cc: Vicki Lake, BTAG Member
California Department of Fish and Game
1700 K Street, Suite 250
P.O. Box 944209
Sacramento, CA 94244-2090

John Bradley
U.S. Fish and Wildlife Service
Carlsbad Field Office
2730 Loker Avenue
Carlsbad, CA 92008

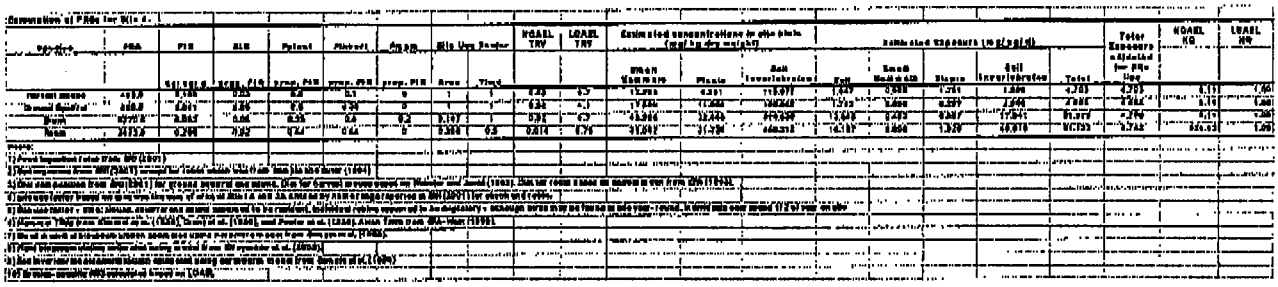
Laurie Sullivan, BTAG Member
Coastal Resources Coordinator (H-1-2)
c/o U.S. Environmental Protection Agency
75 Hawthorne Street
San Francisco, CA 94105

Denise Klimas, BTAG Member
Human and Ecological Risk Division
8800 Cal Center Drive
Sacramento, California 95826

Julie Menack
California Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA 94612

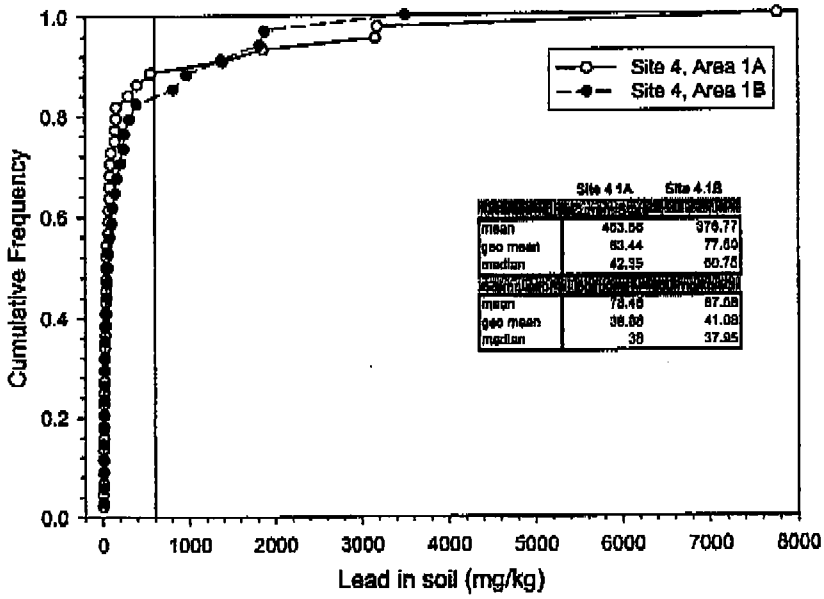
818-551-2853 Voice
818-551-2841 Facsimile
C:\Risk\SEAL\Site 4 EE-CA.doc/h:16

ATTACHMENT A: SPREADSHEET CALCULATIONS REGARDING PROPOSED LEAD ECOLOGICAL REMEDIAL ACTION OBJECTIVE (ERAO) FOR THE PERIMETER ROAD OF THE NATIONAL WILDLIFE REFUGE (NWR) AT NWS SEAL BEACH.



ATTACHMENT B: FIGURE OF LEAD SAMPLE CONCENTRATIONS AND THE PROPOSED LEAD ERAO FOR THE PERIMETER ROAD OF THE NWR AT NWS SEAL BEACH AS SUBMITTED TO HERD. LEAD CONCENTRATIONS REFER TO SITE 4 AREA OF CONCERN 1A AND 2A.

Distribution of lead in soil at Site 4 Areas 1A and 1B.



California Regional Water Quality Control Board
Santa Ana Region

Winston H. Hickox
Secretary for Environmental Protection

Internet Address: http://www.swrcb.ca.gov/rwqcb8
3737 Main Street, Suite 500, Riverside, California 92501-3348
Phone (909) 782-4130 - FAX (909) 781-6288

Gray Davis
Governor

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our website at www.swrcb.ca.gov/rwqcb8.

July 17, 2003

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To BRYANT W. From SI
Dept./Agency Phone #
Fax (714) 424-2065 Fax #
NSN 7540-01-317-7368 5099-101 GENERAL SERVICES ADMINISTRATION

Ms. Pei-Fen Tamashiro
Installation Restoration Coordinator
Naval Weapons Station, Seal Beach
800 Seal Beach Boulevard
Seal Beach, California 90740-5000

COMMENTS ON APPENDIX F, DRAFT ADDENDUM TO THE ENGINEERING EVALUATION/COST ANALYSIS, NON-TIME CRITICAL REMOVAL ACTION FOR SITE 7, SITE 4 AREAS OF POTENTIAL CONCERN 1A AND 2A, NAVAL WEAPONS STATION, SEAL BEACH

Dear Ms. Tamashiro:

We have reviewed the above referenced document, not dated, which we received May 22, 2003. We have the following comments:

F2.5.2 Health and Environmental Effects Associated with Chemicals of Concern and Threat to Nearby Human Populations and Environment, F2.5.2.1 Lead, Page F2-19: For the nearby 880-acre Bolsa Chica coastal wetlands restoration project, the site specific lead LCI T50 is 96 mg/kg and twice the ERM is 654 mg/kg.

For any questions please call me at (909) 782-4494 or email at jbroderic@rb8.swrcb.ca.gov.

Sincerely,

John Broderick
SLIC/DOD Section

cc: Mr. Si Le, NAVFACENGCOM, Southwest Division
Ms. Katherine Leibel, DTSC, Office of Military Facilities
Mr. John Bradley, Seal Beach National Wildlife Refuge

City of Seal Beach

CITY HALL 211 EIGHTH STREET
SEAL BEACH, CALIFORNIA 90740
(562) 431-2527 • www.ci.seal-beach.ca.us

June 16, 2003

Department of the Navy
Naval Weapons Station Seal Beach
Attn: Pei-Fen Tamashiro
Installation Restoration Coordinator
800 Seal Beach Boulevard
Seal Beach, CA 90740

Dear Ms. Tamashiro:

SUBJECT: **CITY OF SEAL BEACH COMMENTS RE: "DRAFT ADDENDUM TO THE ENGINEERING EVALUATION/COST ANALYSIS (EE/CA) NON-TIME CRITICAL REMOVAL ACTION FOR IR SITE 7, SITE 4 AREAS OF POTENTIAL CONCERN (AOPCS) 1A AND 2A, NAVAL WEAPONS STATION, SEAL BEACH"**

The City of Seal Beach has received the above referenced document and is providing comments based on a staff review of the document. The City prefers to have the Environmental Quality Control Board review documents of this nature and respond with any written comments that they determine to be appropriate. Due to the shortened review and comment period on this document, this is not possible for this particular document.

The City of Seal Beach concurs with the determination of the Navy to implement Alternative 2, "Excavation and Offsite Removal". The proposed removal action offers a high degree of protectiveness for human health and the environment by removing the lead-contaminated soils from Site 4 AOPCs 1A and 2A, which pose a risk to ecological receptors. This alternative will:

- Adequately protects public health and safety and the environment
- Complies with "Applicable or Relevant and Appropriate Requirements" (ARARs)
- Meets the "Removal Action Objectives" (RAOs)
- Provide moderate long-term effectiveness
- Provide short-term effectiveness because of low impacts on the community, workers, and the environment

- Provides high technical feasibility and low administrative requirements
- Provides high reasonableness of costs, offering the highest benefit in terms of achieving the RAOs for the estimated cost.

The City of Seal Beach also concurs with the "target cleanup goal" (TCG) level. The City understands that the TCG has been reviewed and approved by the Human and Ecological Risk Division of the California Department of Toxic Substances Control (DTSC). Additionally, DTSC has stated that the human health risk did not appear to be an issue, particularly due to the low exposure related to intermittent travel on the perimeter road.

Thank you for allowing the City the opportunity to review and provide comments on this document. Please contact my office at your earliest convenience if you require additional information or have questions regarding this letter. I can be reached at (562) 431-2527, extension 313, or by e-mail at lwhittenberg@ci.seal-beach.ca.us.

Sincerely,

Lee Whittenberg
Director of Development Services

Distribution: Mayor and City Council
Chairman and Members of the Environmental Quality Control Board

John Bahorski, City Manager